FEBRUARY

THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

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DON'T MUTILATE OR

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Abnormalities of Articulation—*Goodfriend*
Progress of Dentistry—*Haggard*
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Endocrines and Teeth—*Schour*
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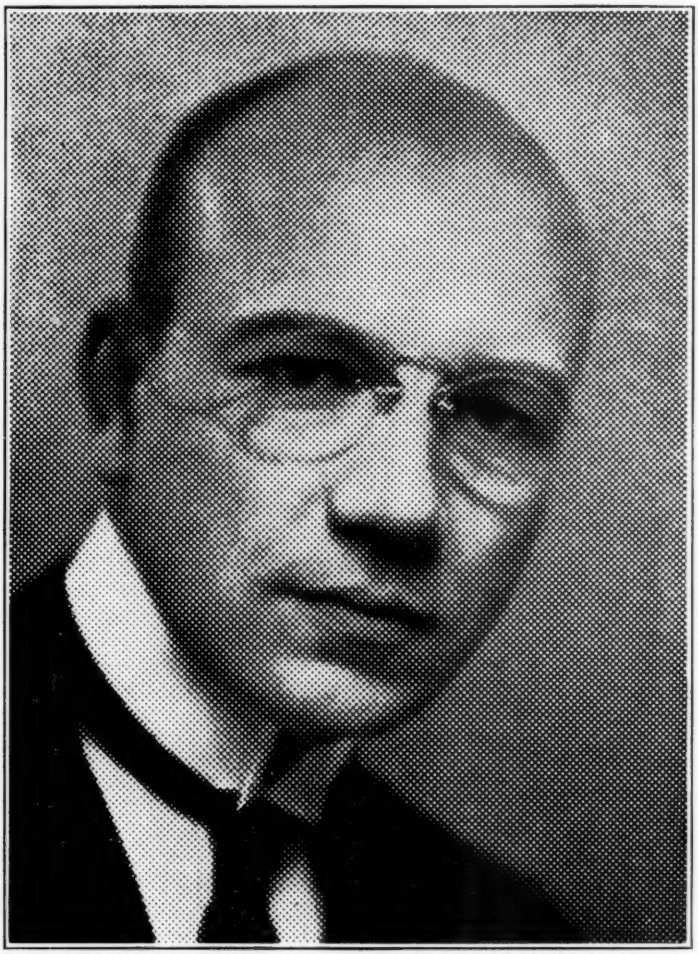

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THE JOURNAL
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Original Communications

A NEW, SIMPLE AND ACCURATE TECHNIC FOR OBTAINING BALANCED AND FUNCTIONAL OCCLUSION*

By F. S. MEYER, D.D.S., Minneapolis, Minn.

MY inlay technic is different from all others. Last year, I presented a new technic in which every step is different from every step in any other technic, namely, a technic for casting bridges in one unit to accurate balanced and functional occlusion. This year, I have something to offer in a different branch of dentistry, something which I believe to be entirely new.

Having reduced to utter simplicity one of the most complicated problems in bridge construction, namely, balanced and functional occlusion, I turned my attention to the same problem in full denture construction. I realized that if it were possible to build a full upper and lower denture to a true balance, that is, a balance such that all opposing cusps would touch with equal pressure in every position of the mandible, there must be a path between the opposing teeth which every cusp must make contact with in the various movements of the mandible. That being the case, if we could locate this path and register it in its proper relation to the ridges in the mouth, all that we should have to do to build dentures to balance would be to set the teeth so that their cusps all touched this path.

With that theory in mind, I set about building my first full upper and lower denture. I used a 25-cent crown articulator and two plaster stops to maintain the proper relation of the casts to each other. I felt that, in order to carry out my plans as I had hoped to, I should make every effort to obtain the best possible suction and stability in the trial plates. Accordingly, I vulcanized the upper and lower bases. This had the desired results as far as stability and ob-

*Read at the Seventy-Fifth Annual Session of the American Dental Association in conjunction with the Chicago Centennial Dental Congress, Aug. 8, 1933.

taining the true paths is concerned, but it carried with it too many objectionable features to be continued. I shall, therefore, describe the technic as I am now carrying it out, explaining later on why I had to discontinue using the vulcanized bases. Before going on, I must say that, in this first set of dentures built by the new technic, I obtained a better balance than I had ever seen in my thirty years of practice up to that time.

The impressions are taken and the casts are made in the usual way. A set of trial plates are also made in the usual way. Before the trial baseplates are adapted to the cast, the latter is placed in very hot water. This serves a double purpose, preventing adherence of the baseplate to the cast and also preventing the cold cast from chilling the warm baseplate. Thus, it facilitates the adaptation. These trial plates must give us the length of the upper anterior teeth, the length of the lower anterior teeth, the total vertical dimension, the median line and the contour or fullness of the anterior teeth. We are not interested at this time in the position of the posterior teeth.

We must now build three more sets of baseplates. A baseplate material must be chosen which has the least volume change with change of temperature. A relief for the palate is inserted and the cast is prepared for postdamming. The upper baseplates are then readjusted. We then have baseplates that will have nearly as good suction as the finished dentures.

The first set of the baseplates is built up in compound, with ridges about twice (or a little more) as wide as the molar teeth, to a height about 3 mm. short of the trial plates. They are covered with a double thickness of pink carding wax to the full width of the compound ridges. A piece of No. 60 tinfoil is cut out to fit the tops of these ridges and sealed to place on the carding wax with a little heat. The tinfoil ridges are vaselined, and these trial plates are inserted in the patient's mouth. For reasons to be stated later, we shall call these trial plates the trial wax paths to distinguish them from the first trial plates. The patient is urged to go through the various mandibular movements with the trial wax paths under biting pressure. In a few moments, the curve of the ideal path for that patient will begin to appear. These movements of the mandible are continued until the vertical dimensions approach those of the first trial plates. These plates are taken out and the distance measured from some point on the anterior ridge to the tinfoil ridge. These distances are compared with the corresponding distances on the first trial plates.

You will probably find that the vertical dimensions of these trial wax paths will not correspond with the vertical dimensions of the original trial plates even though their total vertical dimensions might chance to correspond. But you will also find other discrepancies. The hard compound under the carding wax will show through and interfere with the true curve in various places. The compound is cut away where it interferes with the true curve. Then the trial wax paths are built up with more carding wax 2 mm. above the desired height as shown from the first trial plates. The mandibular movements are repeated with the wax paths in place, and whatever corrections are possible are made where the wax paths fail to maintain contact. When the wax paths appear to maintain contact in every possible position of the mandible, the patient is asked to close in centric relation in the rest position. With large wire staples, the wax paths are tied together and the plates are mounted on the plane line articulator.

Now what have we? The upper and lower trial wax paths mounted in their

proper relation to one another, or nearly so. The curves on the wax paths are very close to the desired true curves. We call these the trial functional occlusal paths in wax, or, for short, the trial wax paths to distinguish them from the final wax paths and the plaster paths to be described presently. The two set screws are adjusted to maintain the proper bite opening, and tightened.

On examination, we shall find that these trial wax paths have an uneven thickness of carding wax between the hard compound and the tinfoil. The more even the thickness of this carding wax, the more accurately described will be the final wax path. And accuracy is what we are after. We therefore want to obtain the final wax path with the same thickness of carding wax under the tinfoil over all parts of the ridge. We also wish to start with the curve on the wax path nearly correct. We can then easily get nearly an ideal accuracy. We do this as follows.

Remove the lower trial wax path and replace with one of the baseplates. Build this up in compound close to the opposing wax path. Pour some plaster or stone over this and close the articulator. This transfers the upper functional path in wax to a lower functional occlusal path in plaster. Make the upper functional path in plaster in a similar way. We call these the trial plaster paths.

Replace the original upper trial plate in the articulator. Open or close the articulator (as the case may require) until it has the right opening for this trial plate. Set the adjusting screws and you have the correct vertical dimensions for the upper denture. Now replace the upper trial plate with the trial wax path. Remove all the carding wax and build it up in compound to within about 2 mm. of the lower trial plaster path. Build this up with two thicknesses of pink carding wax and cover with tinfoil and vaseline. Rebuild the lower trial wax path in a similar way. Now close the articulator until the wax paths touch in their anterior portion. We are now ready to seek the final and correct wax path. This should not take long, for we have close to the desired path to start with. We will also have an even thickness of soft carding wax under the tinfoil when we reach the correct vertical dimensions.

Replace these wax paths in the patient's mouth and continue the mandibular movements until the desired vertical dimensions are obtained.

During this process, check occasionally to see that nothing is disturbing the generation of the true path. Have the patient hold in the right lateral, then the left lateral position, and see if there is any tendency to separating of the two wax paths. If, in the right lateral movement of the mandible, the wax paths should separate on the right side, it means that the balanced occlusal curve (the curve generated by the lateral movements of the mandible as distinguished from the curve of Spee or that generated by the protrusive and retrusive movements) is too great. Correct this by forcing the softened wax of the upper bite rim down on the buccal aspect. This diminishes the degree of the curve.

A word of explanation might not be out of place. It is true that we lessen the lateral balanced occlusal curve by forcing the wax on the buccal aspect down, but at the same time we increase the curve of Spee. Therefore, we have to continue the mandibular movements for further corrections. If the curve of Spee were increased too much, it would be wise to make the correction by raising the wax on the lingual aspect; and thus the corrections are made at all points. If, in the left lateral movement of the mandible, the wax paths should separate

on the right side, it means that the balanced occlusal curve is not great enough. Increase the height of the wax on the buccal aspect of the lower right bite rim. The corrections on the opposite side are made in a similar way. If, in the protrusive movement of the mandible, the wax paths should separate in the incisal region, it means that the curve is too great. Make corrections. If, in the retrusive movement of the mandible, the wax paths should separate, the curve is not great enough. Make corrections. After each correction, continue the mandibular movements. If either of the wax paths should approach the desired vertical dimension before the other, chill the former and continue the movements.

When the correct vertical dimensions are approached, the wax paths should maintain contact at all points with every position of the mandible. We are sure then that if the remaining part of the technic is carried out correctly, the dentures will balance. There can be no guesswork about that. But we cannot build the teeth against this soft wax. We must, therefore, register these paths in some hard substance against which we can safely set the teeth without any danger of distorting the paths. We do this in plaster or, better still, in stone. This is done in the same way that we obtained the trial plaster paths.

Greater accuracy should be sought in transferring these wax paths to the articulator than was necessary with the trial wax paths. If there is any possibility that we might open or close the bite in setting up the teeth, the use of the facebow is of material advantage. It is indeed most unfortunate that this valuable instrument has not been more generally used. The gothic arch tracer is also of great value in obtaining centric and rest position. As the greater bulk of wax may tend to throw the denture off centric, greater care is necessary than with an ordinary bite. If the denture should be off centric, it will not be necessary to take the bite over, but merely to move the lower teeth over and check in the mouth.

I find that only by the use of large wire staples can the two wax paths be held together in transferring to an articulator. These are inserted in the compound beyond the wax. It will be necessary to remount the upper cast with the finished correct wax paths before pouring the plaster paths.

When the last plaster paths are poured and replaced on the casts and the articulator is closed, they will not meet accurately as the wax paths did, for the reason that, near the edges of the wax paths, the wax folds back. The plaster paths will be too high at these points by the amount that the wax folds back. This is no cause for worry as the teeth are not set to meet the plaster paths near the edges. The functional occlusal paths are more than twice as wide as the teeth and we are concerned only with the middle or most nearly correct part.

Place the original upper trial plate in position on the cast and pencil the outline of the contour on the lower plaster path. This gives the line to which to set the upper anterior teeth. If the bases were vulcanized on the original casts, as in my first case, we would have to destroy the above-mentioned contour in order to make the wax paths on them. Then, after pouring plaster into the vulcanized bases to make the plaster paths, we would have to destroy the wax paths in order to set the teeth up on them. Besides affording a double vulcanization and the consequent shrinkage, it can be seen why the vulcanizing of the bases was discontinued.

We are now ready to build the dentures in wax. Coat the plaster wax paths with cocoabutter to prevent any wax

sticking if by chance it should drop on them. Set the incisors to meet the outline of the upper trial plate contour penciled on the lower plaster path. Grind the incisal edges to meet the path. Have the articulator short of closing by a very slight amount. Flatten the cusps somewhat on the bicuspids and molars. And when I say flatten the cusps, I realize that I am creating opposition in the minds of some of my readers. You have been taught to build dentures with interlocking cusps, and it will be hard for some to conceive a set of dentures with flattened cusps. Consider the human teeth in natural dentition. Cusps interlock with cusps of the teeth in the opposing arch. If the teeth get normal wear, the cusps will be gradually worn down until from 50 to 60 years, they will be quite flat. There will be little or no tendency for the cusps to interlock. The gums will remain healthy and the teeth will be firmly seated in the process. But if the teeth fail to get normal wear and the cusps continue to interlock, trauma usually follows and pyorrhea sets in. Shall we, in artificial dentures, employ flattened cusps which tend to produce stability, or shall we continue to produce dentures with interlocking cusps, producing instability and causing trauma followed by absorption and loosening of the dentures? Shall our patients chop their food as they have often been compelled to in the past with artificial dentures, or shall they learn to grind their food without cusp interference? I shall have more to say on this phase of the subject.

The bicuspids and the molars are set up so that these flattened surfaces touch the path. The lower plaster path is removed occasionally for assurance that the bicuspids and molars bear the proper relationship to the lower ridges.

We are now ready for building the lower denture in wax. Remove the lower plaster path and check the vertical dimension of the lower denture with the lower trial plate. Replace with the baseplate. Set the lower anterior teeth in their proper relation to the upper with the articulator slightly opened. Replace the upper denture with the upper plaster path. Adjust the lower anterior teeth to meet the upper plaster path along the incisal. Then repeat the same process with the bicuspids and molars. Adjust both the upper and lower dentures so that the occlusal and incisal edges meet the plaster paths with the articulator fully closed at the formerly determined bite opening.

When we are trying in the teeth for esthetic values we may discover certain discrepancies, finding that the vertical dimensions do not quite suit us, or that the upper or the lower dentures show the teeth too prominently or not enough. If the discrepancy is not large, we may correct it by opening the bite when setting up one of the dentures and closing it when setting up the other, thus leaving the vertical dimensions the same, greater, or less, as desired. If the discrepancy is too great, it will be best to lengthen or shorten one or both of the wax paths on the articulator until both are just a trifle higher than the desired vertical dimensions and repeat the bite-taking in the mouth, then pour the plaster paths over again. If the denture is off centric with the median line of the lower to the right or left when it is tried in the mouth, move the lower teeth over to the opposite side of the median line on the articulator as much as they appear to be off centric in the mouth, all the way meeting the opposing plaster path. On again being checked in the mouth, they will probably fall into centric relation and balance. If they should be protrusive, they can be corrected in a similar way. This, of course, never will be necessary if a gothic

arch tracer is used. If one or more of the teeth should fail to make contact with the opposing teeth when the dentures are in place on the articulator, the opposing path should be examined for discrepancy. The wax is softened under the one meeting the faulty path and the slight correction necessary is made for contact with the opposing teeth. It should not be necessary to make any corrections in the mouth if dentures are vulcanized or pressed in stone. So far, I have not found it necessary to make any.

In case conditions demand an overbite as well as an overjet, the curves or paths are generated in a different way; and if conditions should require interlocking cusps, they may also be used, following out the idea of building to a path. It is possible to build a full upper denture without touching a stone to a single cusp and then build a full lower denture with cusps interlocking with it and accurately balancing with it when placed in the mouth. These phases of the subject will be taken up at a later date.

When a new technic is brought into being, obstacles will appear from time to time to hamper the work. This technic will be no exception to the general rule. I shall give a few of them as they have arisen up to this time and explain how they were overcome.

In the protrusive and retrusive movements of the mandible, there may be a tendency for the upper wax path to drop a little owing to lack of suction. To correct this, the baseplate is adapted to the cast as nearly accurately as possible. The cast is prepared for the postdamming with a full-sized relief area under the wax path plate. One of the many suction powders might be used to advantage, although I have never been called on to use them.

If there is a tendency for the path or the curve of Spee to fade out in the molar region, which is shown by a drop of the wax path in that region, we continue the curve in the lower wax path in the molar region by building it up with a little more compound or harder wax under the carding wax. We then compress the corresponding part on the above-mentioned wax path, and repeat the mandibular movements in the mouth to correct the slight discrepancy. If the suction is not strong enough, we cut a notch in the compound on each side of the wax path in the molar region. This will afford a grip to help steady the wax path in taking the bite.

If a portion of the wax should appear to be flattened, we look for a hard area of compound posterior to this area and immediately under the carding wax and tinfoil. If we do not find it there, we look for it directly opposite the flattened area.

The more even the thickness of carding wax under the tinfoil, the more accurate the registration. If there should be an uneven thickness of carding wax under the tinfoil when we are close to the desired vertical dimension, it is well to remove the wax paths tied together and correct this as already described in this paper.

We may obtain a patient who may fail to give us the desired movements of the mandible. Some can move only to the left and others to the right. Some others can give only the protrusive and retrusive movements. Still others may give only a circular movement. Some will be able to exert considerable pressure on the paths in the various movements, and others very little. In the latter cases, we may assist them in getting started by exerting a little pressure on the chin. This tends to emphasize the curve in the path and should be avoided in obtaining the registration. If the patient fails to create the proper masticating force, it is well to soften the wax paths a trifle in warm

water. Excessive bulk of wax, especially in the posterior region, may hinder the movements of the mandible. Irritation along the plate rim may hinder normal movements of the mandible. The excess of carding wax appearing on the sides of the path when the patient goes through the mandibular movements may also tend to hinder the movements. All excess wax should be trimmed away.

If, in vulcanizing, a tooth should be lengthened, it can be located by placing the denture in the mouth opposite the plastic path. If the tooth should be shortened, we face a greater problem. If some good stone is used to imbed the teeth in vulcanizing or pressing, there will be no distortion.

The first case of full upper and lower dentures that I ever made with this technic was completed about a year and a half ago. It was purely experimental and as a result I failed on the vertical dimensions, which were about 5 mm. too great. The balance was accurate in every position of the mandible. Not a cusp was touched from the time the denture went to the laboratory in the wax. They were in end-to-end occlusion.

I then decided to make a case with an overbite and an overjet. This called for new conditions. I succeeded in making a successful set with an accurate three-point balance, which is all that can be obtained when there is an excessive overbite. My patient wore these for over a year without touching a stone to a cusp from start to finish; but as the conditions were such as to call for an end-to-end bite, I decided to make a new set with a "resovin" base. These were most successful, and to this day I have not touched a stone to a cusp. About six weeks after the case was finished, the patient was in the office. At that time, I had a class taking up bridgework cast to balance and function, and I invited them to see the dentures. I then replaced these plates with the dentures that I had made over a year before. They fit as well and were in accurate balance, just as when they were made. Not a stone had been touched to any cusp since they came from the laboratory. To experiment, I replaced the new lower with the old upper. To my astonishment, they were in accurate balance, and this balance was accurate in the most extreme positions of the mandible as well as in the narrow ranges. The new upper was then replaced with the old lower. This was also in fair balance as far as could be determined by any test that we could give them.

This with other experiments brought me to the following conclusions:

1. Full upper and lower dentures must be in balance in extreme positions of the mandible in order to be in accurate balance within narrower ranges.

2. Even if the dentures are in balance in the extreme positions of the mandible, they may still be so only because of the give of the oral tissues.

3. If dentures are in balance within narrow movements of the mandible and not in extreme positions of the mandible, they are so only because of the give of the oral tissues.

4. The correct relationship of the curve of Spee to the balanced occlusal curve to the mandible must be known and registered in order to build a set of dentures to an accurate balance.

5. If it were not for the give of the oral tissues, no dentures built in the past could ever have approached a balance except by accident.

6. With true balance established, it is quite likely that denture stability may be greatly prolonged.

A year ago last January, I read a paper before this society discussing balanced and functional occlusion in full cast bridges. That technic applied only

where I had other teeth in the mouth to act as a guide. It did not apply when I had to build up a mouth, as in opening the bite or in denture work. But that technic led to my working out the denture technic which I have just described. In turn, the denture technic led me to where it was possible to cast a full upper and lower bridge to an accurate balanced and functional occlusion. I can best describe this technic by describing the various steps that were taken in an experiment carried out last winter.

Cases wherein we are called on to build up a mouth with full upper and lower bridges are rare, and it would be still rarer to find it possible to bring the patient along to help in teaching the technic. I therefore chose a Gysi simplex articulator to represent my patient. On this articulator, I mounted models for a full upper bridge on six abutments and a full lower bridge on four abutments at an arbitrary bite opening. The abutments were prepared on porcelain teeth set in vulcanite. Of these, I took impressions and made amalgam dies, which I transferred to stone models. I then cast low fusing metal bridges on the amalgam dies in the same manner as described last year for smaller bridges. These low fusing metal bridges had to meet the same conditions; namely, they had to rest rigidly on the dies as well as on the original abutments; they had to go to place both on the dies and on the original abutments; they had to be broader than the occusal surfaces of the teeth, and they had to be shorter in occlusion than the finished bridges were to be. These low fusing metal bridges were covered with wax and tinfoil and were vaselined as were the wax paths in the denture technic. They were then placed on the models on the Gysi simplex articulator. The Gysi articulator was put through the various movements of which it is capable, generating the desired path just as was done with the wax paths in the denture work. Where the low fusing metal bridge interfered with the path, it was cut away as much as possible; but in the case of the bridgework, the wax paths showed greater stability because they were anchored on rigid abutments instead of on resilient tissue. When the wax paths were generated, they were tied together with wire staples and then transferred to the plane line articulator, as with the case in the denture work, only here they were mounted on amalgam dies set in plaster models. Plaster paths were then poured against the wax paths, but they were poured on low fusing metal bridges built up in compound to close to the desired vertical dimensions.

The correct vertical dimensions were obtained as follows: Low fusing metal bridges were cast to the anterior abutments. These were then built up in compound to the desired vertical dimensions for both the upper and lower anterior teeth. These were checked in the mouth (in this case, on the Gysi simplex articulator) for corrections. These vertical dimensions were then maintained with the set screw on the articulator. Wax abutments were built up on the lower dies with occlusal and incisal surfaces to meet the plaster paths. This was all done on the plane line articulator. The facings were procured and alined as with smaller bridges, and the matrix was poured, the root tips baked, and the occlusal and incisal margins of facings were trimmed to allow for the correct amount of gold to protect them in mastication. Meeting the functional occlusal path, it was possible to have the same thickness of gold along the incisal and occlusal margins of all the facings. This part of the technic is the same as

in the case of smaller bridges. The lower wax bridge was then assembled, invested, eliminated and cast. In waxing together the abutments and dummies, there were slight discrepancies, which were checked with the plaster path and corrected after the bridge was cast. The lower bridge was cast, the adjustments were made and the polishing was completed before the upper bridge was started.

To build the upper bridge, I had to change the technic somewhat from that used either in the denture work or in the smaller bridge work. I replaced the lower bridge on the model on the Gysi articulator. I then covered the low fusing metal bridge on the upper model with hot compound. The plane line articulator was closed to the correct vertical dimensions. The trial plate or path in compound was chilled. The compound path was reheated over the surface and replaced in the mouth (in this case the Gysi articulator). The patient was allowed to close in centric. I trimmed away all the compound except that which filled in the grooves of the opposing bicuspid and molar teeth as well as that which flowed in between them. This was left to guide the movements of the mandible (in this case, the Gysi articulator). This was filled up level with pink baseplate wax. The functional occlusal path of the lower bridge was generated in this wax, the compound ridges guiding the movements just as the adjoining teeth guide the movements in the case of smaller bridges. This path was transferred in stone to a lower low fusing metal bridge. To this path, an upper bridge was waxed and cast just as all my shorter bridges are cast. When this upper bridge was adjusted to the plaster path, it functioned very well with the lower bridge when replaced in the Gysi articulator. This is far more difficult than to make one function in the mouth, where there is some give in the tissues.

I just recently cast my second full mouth upper bridge to function with a lower partial denture. It was very successful. A year and a half ago, I cast an eleven-tooth lower bridge with a balanced occlusion curve upside down. It balanced accurately with an upper full denture ground to meet the same curve.

The idea of establishing balance both in bridgework and in denture work by building to a path generated by the individual patient has been perfected and proved beyond question. What is more, it is, I believe, the only way that accurate balance can be established.

I realize, of course, that there are many problems yet to be solved, but I believe that this technic in one form or another will meet all these problems. We have many good technicians, and among us all I feel sure that we shall be able to work out a technic which is beyond our fondest dreams of yesterday.

ABNORMALITIES OF THE MANDIBULAR ARTICULATION*

By DAVID J. GOODFRIEND, D.D.S., Philadelphia, Pa.

A MORE complete knowledge of the mandibular articulation is important as a basis for (1) repositioning the mandible in prosthodontia, (2) establishing a normal intermaxillary relationship in orthodontia, (3) establishing occlusal balance in operative restorations and (4) the treatment of the joint and reflex symptoms associated with abnormalities of the mandibular articulation.

This research, which was inspired by Edward C. Kirk, in 1925, and has since been conducted at the University of Pennsylvania, was prosecuted in order to standardize the normal and to determine the symptoms, pathology, etiology and treatment of the abnormal joint. Investigations of this problem were made in anatomy, roentgenology, psychology, histopathology, statistics and the treatment of cases.

The anatomic approach included the dissection of cadavers, with normal and abnormal chewing mechanisms; and a review of the works of the various anatomists and research workers in this field.

The roentgenologic approach included the study of the mandibular articulation, normal and abnormal, in the closed and the opened positions.

The psychologic phase of this research is concerned with speech and personality. This approach of the problem included the study of defective speech cases and the treatment of thirteen patients selected because they had speech defects associated with malocclusion and traumatic movements of the mandibular articulation.

The histopathologic phase of this research was confined to a study of the works of Redfern,[1] Phelps,[2] Axhausen,[3] Konjetzny,[4] von Staplemohr,[5] Dufourmental[6] and others. The statistical research included two experiments which were conducted in order to determine the relative group occurrence of occlusal anomalies and the correlation of abnormalities of the mandibular articulation with disturbances of the ear. The first experiment consisted of a study of undergraduates of the Evans' Dental Institute in which facial measurements and audiometric tests were made and the dental occlusion was typed. In the second experiment, an examination was

*Read at the Seventy-Fifth Annual Session of the American Dental Association in conjunction with the Chicago Centennial Dental Congress, Aug. 9, 1933.

1. Redfern: Month. J. M. Sc., Vol. 9 & 10, 1849-1850.

2. Phelps: Researches of Loomis Laboratory, 1:65-74, 1890.

3. Axhausen: Deutsche Ztschr. f. Chir., 232:238-272, 1931.

4. Konjetzny, G. E.: Zentrabl. f. Chir., 56:3018 (Nov. 30) 1929.

5. Von Staplemohr: Acta. Chir. Scand., 65:1, 1929.

6. Dufourmental: Chir. L'Articulation Temporomaxillaire, Paris, 1929.

made of twenty-five patients at the ear clinic of the University Hospital. The dental occlusion was typed, facial measurements were taken and audiometric tests and roentgenographic studies were made. The last was done in conjunction with the roentgenologic phase of this research in cooperation with the roentgen-ray department of the hospital.

STANDARDIZATION OF THE NORMAL MANDIBULAR ARTICULATION

The recognition of abnormality, essential to its study and treatment, depends on the standardization of normality. This

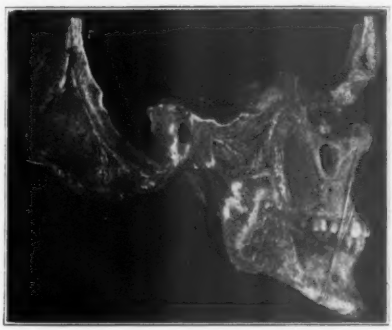

Fig. 1.—Normal mandibular articulation and normal masticating mechanism.

is based upon the following definition: "The normal mandibular articulation is a state of health and function wherein there are normal movements of the joint in the articulation of speech and the mastication of food; and wherein there are no joint or reflex symptoms."

This standardization was approached by research in anatomy, roentgenology and the treatment of cases. These findings show that the normal mandibular articulation has the following characteristics: 1. The temporal surface presents a shallow fossa and a broad eminence. 2. The condyle in cross-section is elliptical and is tilted forward. 3. The articular relationship with the teeth occluded is between the anterosuperior surface of the condyle and the inferoposterior surface of the articular eminence. It is important to note that the condyle is not in contact with the fossa except at the lower part of its anterior wall, which is also the posterior wall of the articular eminence. 4. With the opening of the

Fig. 2.—Normal mandibular articulation with adequate masticating surface in good occlusion.

mouth, the condyle is transposed by a forward gliding, contraclockwise, rotary movement to a position below and in front of the crest of the articular eminence. Therefore, in the normal joint, the movement of the condyle is around the eminence from its posterior third to a point just below and anterior to its crest. The normal joint is illustrated by Figures 1-3.

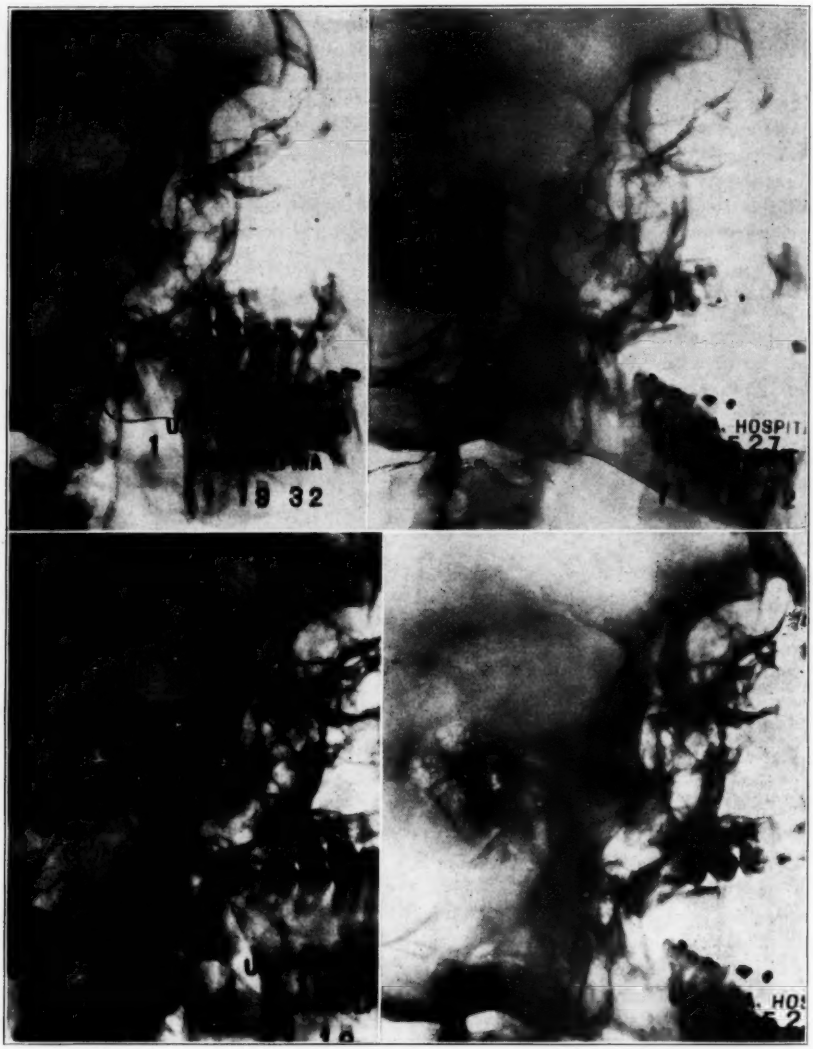

Fig. 3.—Normal arc of condyle movement. Above, outlined; below, before outlining.

ABNORMALITIES

Any deviation from the normal interrelationship of the articular surfaces is considered an abnormality of the mandibular articulation. These have the following characteristics: 1. The temporal surface presents a deeper fossa and a sharper eminence. 2. The condyle is

deformed by resorption of its superior and anterior bone surfaces. 3. The articular relationship with the teeth occluded is between the upper surfaces of the condyle and the roof and anterior wall of the fossa. 4. The opened position of the condyle is either in relationship with the inferior third of the posterior surface of the articular eminence or it may be in front of and above the crest of the articular eminence. Therefore, in the abnormal joint, the movement of the condyle may be confined to the fossa or may extend from its depth to a point in front of and above the articular eminence. The abnormal joint is illustrated by Figures 4-7.

Fig. 4.—Anatomic alterations of mandibular articulation with loss and distortion of masticating surfaces.

HISTOPATHOLOGY

The findings of the work in anatomy, histopathology and roentgenology show that the pathogenesis of the abnormal joint includes changes in the texture of the articular cartilages and disk; alteration of the interarticular relationships and movements; relaxation of the articular ligaments and muscles, and deformation of the condyle, fossa, and eminence. The texture changes are: 1. A loosening up into fibers, and a roughening of the surface of the disk and cartilages, as illustrated by Figures 8-9. 2. Atrophic resorption of the disk. 3. Changes in the disk and cartilages from hyaline to fibro-

Fig. 5.—Anatomic alterations of mandibular articulation with loss and wear of masticating surfaces.

cartilage, fibrous tissue and bone. 4. The calcification of the articular cartilages with toxic and infectious involvements.

Pathology.—Since the alteration of the articular relationship is primarily a superior-posterior displacement of the condyle, the abnormal articulation is between the superior surface of the condyle and the upper portion of the eminence and the mandibular fossa. This abnormality results in an abnormal movement

of the condyle, with the result that it is either confined to the fossa or it extends from the depth of the fossa to a point superior to and laterad from the crest of the articular eminence.

The relaxation of the articular ligaments and muscles is the result of an approximation of their attachments and the atrophy of the disk and articulating surfaces.

The absorption of the bone surfaces of the condyle, fossa and articular eminence is caused by the degenerative processes of the articular cartilagenous surfaces. This may be more readily understood upon the basis of the anatomic principle of the dominance of soft tissue, which is likewise the explanation of the infrequent occurrence of the perforation of the interarticular disk as compared with the observable absorption of the articular bone surfaces.

SYMPTOMS

The local symptoms of abnormalities of the mandibular articulation are noisy, traumatic, painful, limited and excessive movements of the joint, or there may be no joint symptoms whatsoever. This work has proved that either with or without joint symptoms these abnormalities may be evidenced, clinically, by reflex symptoms which include deafness, tinnitus aurium, vertigo, speech defects and personality departures.[7]

The joint symptoms are progressive in nature and usually start with pain or

Fig. 6.—Arc of condyle movement in case of mandibular subarthrosis.

7. Goodfriend, D. J.: D. Cosmos, 74:523 (June) 1932.

crackling noises during joint movements. These noises are primarily heard by the sufferer himself. They are quite annoying, but become a social nuisance later when they may be audible throughout a large room, especially in chewing. There may be an accompanying retardation of the opening movement or pain in one or both joints accompanying occlusal stress. As the condition progresses, the crackling may disappear and return at intervals, or

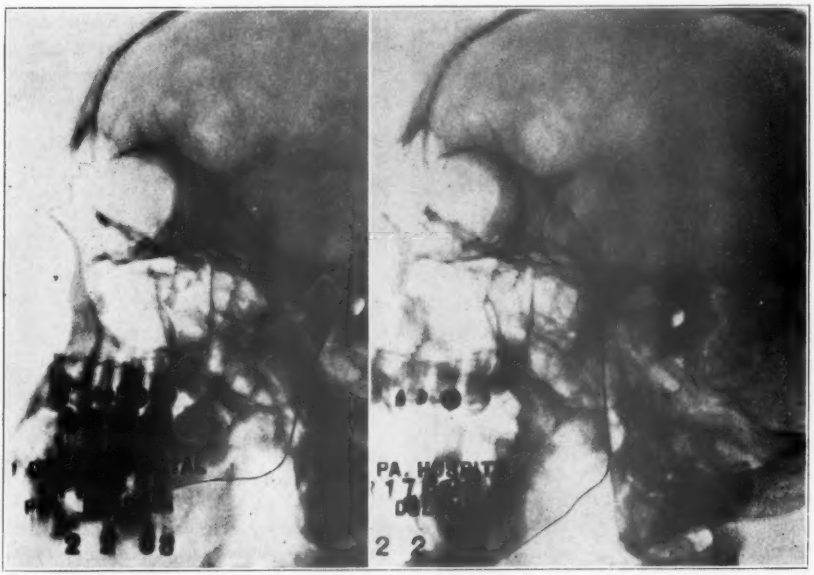

Fig. 7.—Arc of condyle movement in case of mandibular dysarthrosis.

there may be a snapping of one condyle during the opening movement. The joint may "rust" overnight, considerable effort being required in the morning to free it sufficiently that breakfast may be eaten. In many cases, the limitation of joint movement is associated with recurrent disarticulation of the condyle. The pain associated with the dislocation inhibits joint movement and a severe limitation or ankylosis may result. On the other hand, the dislocations may continue with increased frequency, becoming less painful and more easily reduced. This may result in a chronic dislocation of the jaw, which is as distressing as ankylosis, though more easily corrected.

In many of the cases which I have treated, the joint symptoms have disappeared in the early stages and the patients have been unaware of the joint condition; seeking instead the services of the physician for the treatment of the associated reflex symptoms, which this research has indicated to be secondary to the joint disturbance. This was demonstrated by the experiment with twenty-five ear cases. Twenty-three presented abnormalities of the mandibular articulation. The patients, unaware of the dental contribution to their symptoms, sought treatment at the ear dispensary. That dentistry may be responsible for this

state of affairs was shown by the fact that, while five of these patients were referred to the dental school for diagnosis and treatment, no recognition was made of the joint disease in any case.

While joint symptoms are not uncommon, the chief complaints in ninty-one cases that were diagnosed as abnormalities of the mandibular articulation were as follows: Nine sought treatment because of joint symptoms; thirty-three, because of ear symptoms; thirty-six, because of occlusal anomalies, and thirteen because of speech defects.

On this basis, only a small percentage of abnormal mandibular joints are evidenced by the joint symptoms which I have described. It is probable that, in most cases of joint abnormalities, the joint symptoms are not sufficiently distressful to receive the patient's attention, and therefore treatment is put off until the appearance of reflex and associated symptoms, which are then treated without regard to the underlying joint disease. Redfern said, "The symptoms supposed to indicate disease in the cartilages are closely allied to those produced by affection of the bones." In the area of the mandibular joint, the affection of the bones would be accompanied by symptoms in the ear. Of the thirty-three cases with primary complaints of ear symptoms among those treated in conjunction with this research, twenty-three were deaf, twelve had tinnitus aurium, four had eczema of the auditory canal, four had vertigo and two were suffering from otalgia. There was a combination of symptoms in several cases, the principal of which were tinnitus and deafness.

Fig. 8.—Normal disk of normal mandibular articulation. (Axhausen.)

Fig. 9.—Disk of abnormal mandibular articulation (Axhausen) illustrating texture changes and roughened surface.

CLASSIFICATION OF JOINT DISEASES

My observations have demonstrated the relatively infrequent occurrence of joint symptoms as the chief complaint of joint abnormalities. Redfern's demonstration of articular disease in the absence of articular symptoms, which these findings have corroborated, plus the unfamiliarity of dentistry with these conditions is probably the reason for the comparatively small number of cases of abnormalities of the mandibular articulation which have been reported to date. Von Staplemohr found sixty cases in medicodental literature, to which he added eleven; while Axhausen reported the treatment of ten of the thirty cases which he observed.

In order to simplify the diagnosis of joint diseases and their treatment, a classification is submitted herewith:

1. ***Mandibular Subarthrosis.***—This condition, the primary degenerative state of the mandibular joint, is characterized by an abnormal relationship of the articular surfaces, degeneration of the articular cartilage, relaxation of the articular ligaments and either a limited or an excessive articular movement, which may or may not be accompanied by trauma or pain.

2. ***Mandibular Disarthrosis.***—This is defined as the disarticulation of the abnormal mandibular joint and is a sequel of subarthrosis. It is characterized by recurrent or chronic disarticulation of the joint, which results from anatomic alteration and texture changes and is induced by normal acts and reflexes.

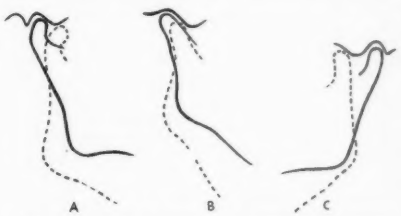

Fig. 10.—Arc of condyle movement of opening of jaw in: *A*, normal; *B*, mandibular subarthrosis; *C*, mandibular dysarthrosis.

3. ***Mandibular Subluxation.***—This is a partial disarticulation of the mandibular joint caused by accidental or extra-articular stimuli.

4. ***Mandibular Luxation or Dislocation.***—This is a complete disarticulation of the mandibular joint caused by accidental or extra-articular stimuli.

5. ***Mandibular Ankylosis.***—This condition, which is also a sequel of subarthrosis, is characterized by limitation of the movements of the mandibular articulation, attributable to intra-articular conditions.

6. ***Mandibular Trismus.***—This is a limitation of the movement of the mandibular joint attributable to extra-articular conditions.

ETIOLOGY

The clinical, anatomic, psychologic and roentgenologic findings show that the causes of abnormality of the mandibular articulation are malocclusion, tooth destruction, disequilibration of masticating stresses, and inflammatory processes of teeth and jaws. These may occur alone or in combination with the others; and with or without toxic and infectious influences.

Fig. 11.—Dissection of mandibular articulation of habitual mandibular repositioning.

The joint symptoms are caused by abnormal pressure of the condyle and disk against an abnormal articular surface. This pressure is abnormal either because the support of the masticating tooth surfaces has been diminished or

lost; or because the mandible has been displaced by occlusal anomalies.

The normal temporal articular surface is the inferior posterior surface of the eminence. This is a smooth cartilaginous surface, while the fossa is covered by a fibrous membrane and presents the glaserian fissure. The friction of this abnormal surface with the disk during the movements of the jaw causes the cartilage and bone changes. (Figs. 4, 5, 8, 9.) The wear of the cartilage and the deformation and absorption of the bony parts of the articulation result in a loosening of the joint and a relaxation of the ligaments. These conditions, with the approximation of the attachments of the muscles of mastication, other than the external pterygoid, result in a mandibular articulation unguided by bone processes, ligaments or muscle tonus. The movements of this pathologic joint may be traumatic and noisy, limited or excessive, thereby causing the clinical symptoms of subarthrosis, dysarthrosis and ankylosis.

Among the symptoms of mandibular subarthrosis, crackling noises are probably caused by a loosening of the attachment of the disk to the condyle. Snapping of the condyle is probably due to the retardation of the gliding movement in the upper joint, caused by the contact of the roughened upper surface of the disk with the posterior portion of the fossa. The condyle snaps forward when this retardation is overcome by muscle activity.

The disarticulation of the condyle in dysarthrosis is probably the result of resorption of the bones and cartilages and the relaxation of the ligaments of the joint.

The acute retardation of joint movements may be a subconscious reaction to a painful disarticulation or it may be a "rusting" of the joint due to cartilage degeneration. An acute limitation of joint movement, unaccompanied by a bite anomaly, may be caused by tooth or bone inflammation in the area of the muscle attachments. Any immobilization of the joint with the involvement of systemic or toxic influences may cause ankylosis. Among the systemic and the toxic influences are dental, tonsillar and arthritic infections.

The causes of the associated reflex symptoms of the ear—deafness, tinnitus and vertigo—are the pathologic factors in the joint abnormality. The deepening of the fossa and displacement and deformation of the condyle are anatomic alterations which involve the ear and eustachian tube in the area of the mandibular joint. The degeneration of the articular cartilages and disk gives rise to symptoms of the underlying bone surfaces. In addition to these factors, there is the traumatic influence of the abnormal condylar movements and the pressure of the approximated surfaces. All these contribute to the cause of the ear symptoms either directly by inflammation or indirectly by reflex nerve pressure. The latter influence is more readily understood when one considers that the nerve supplying the joint is a branch of the auriculotemporal nerve, other branches of which supply the tympanic membrane, the external auditory canal and the tympanic cavity. It is difficult to differentiate the direct and reflex influences, and it is probable that both play an important part in the cause of these diseases. I consider the reflex etiologic factors to be more logical and applicable. Cryer,[8] Monson,[9]

8. Cryer, M. H.: Internal Anatomy of the Face, Philadelphia: S. S. White Dental Mfg. Co., 1901.

9. Monson, G. S.: Impaired Function as Result of Closed Bite, J. N. D. A., 8:833-839, (Oct.) 1921.

and Wright,[10] have shown the probable direct influences; but the number of cases of encroachment of the condyle on the tympanic plate is far too small to explain the high correlation of bite anomalies with ear disturbances. The inflammation of trauma is a predisposing cause of the symptoms associated with the eustachian tubes; i. e., head noises and tinnitus; while the exciting cause is infectious involvement from the nose and throat.

The influence of mandibular joint disease on deafness is predisposing by trauma and inflammation; and exciting by reflex neurosis of the auriculotemporal nerve.

The etiologic rôle of mandibular abnormalities in vertigo is the same as that of deafness, with the involvement of focal infection.

DIAGNOSIS

The diagnostic procedures include roentgenographing the teeth and mandibular articulations and making model and landmark studies of the dental arches, facial measurements and a study of the condylar movements.

The diagnosis of the roentgenograms of the teeth includes the consideration of areas of periapical and peridental rarefaction and dental caries, ill-fitting prostheses and impacted teeth. The roentgen-ray study of the mandibular articulations is made in the opened and closed positions of the joints from the lateral aspect. These are diagnosed on the basis of the standardized normal joints. (Figs. 1, 2, 3, 10*A*.) The views of the opened joint are the most important basis of diagnosis. The opened condyle posterior to the crest of the articular eminence is evidence of a posterior displacement of the arc of condylar movement, and a subarthrosis. (Figs. 6 and 10*B*.) If it is above and in front of the crest of the articular eminence, there is a dysarthrosis. (Figs. 7 and 10*C*.)

The model and landmark study consists of a comparative consideration of reproductions of the dental arches, mounted by a facebow and T-piece transfer to a Wadsworth articulator, with the landmarks of the maxilla, mandible and face. This study is based upon the anatomic, psychologic and clinical evidence of the rôle of bite anomalies and tooth destruction as etiologic factors in mandibular joint disease. The landmarks are the lip frenum, the mesio-incisor points, the cuspid and first molar teeth and the facial dimensions.

The facial measurements have not been standardized as a basis of diagnosis, but, for present purposes, it is well to familiarize oneself with the following dimensions in order to formulate a personal valuation of normality. (1) from the pupil point to the commissure of the lips; (2) subnasion to menton; (3) auditory point to nasion; (4) auditory point to subnasion; (5) auditory point to superior prosthion; (6) auditory point to mesio-incisor point; (7) auditory point to inferior prosthion; (8) auditory point to menton.

The diagnostic importance of noisy, traumatic, jerky, painful, excessive or limited joint movement is dependent on the findings of the foregoing procedures. A snapping of the jaw to one side indicates a retardation of the forward movement of one condyle. The snapping movement is the result of the muscle pull overcoming the obstruction and the chin is therefore snapped in a direction away from the defective joint. In the limitation of jaw movement, the first movement of the chin is in the direction of the defective joint. If the two joints are equally diseased, the chin remains in the

10. Wright, W. H.: Deafness as Influenced by Malposition of Jaws, J. N. D. A., 7:979-990 (Dec.) 1920.

midline. If the one is worse, the chin moves in that direction.

The lateral displacement of the condyle may be diagnosed by placing the fingers on the side of the patient's face just below the zygomatic process, during the opening and chewing movements of the jaw.

The posterior displacement of the condyle may be diagnosed by placing one's little fingers in the patient's ears during swallowing and the closing movements of the jaw.

In the diagnosis of cases of excessive movement, normal acts such as yawning and laughing are not considered as etiologic factors. Joints that are disarticulated by these or less severe actions may be considered to be spontaneously or chronically disarticulated and the condition is therefore diagnosed as "mandibular dysarthrosis."

Inflammation and infection in the region of the third molar teeth, periapical or tonsillar foci of infection and inflammation of the parotid gland or ear are contributing factors in acute limitation of joint movement and therefore are guides in the diagnosis of ankylosis.

In making a diagnosis, each joint must be considered individually because of the common occurrence of unilateral joint disease. If one or both joints are abnormal, focal or systemic infection must be considered as a serious threat to the future health and function of that joint. Articular cartilage changes, which may otherwise be self-arrested or reversed by correction of the mechanical causes, undergo osseous degeneration in the presence of toxic complications with permanent and distressing results.

TREATMENT

The present treatment for abnormal mandibular articulation is varied, radical and symptomatic and without due regard to its effect on the surrounding structures and the reflex symptoms. It includes surgical therapy for the removal or folding of the disk; the formation of new joints; the suturing of the capsule, and the production of therapeutic synovitis. Axhausen and Dufourmental recommend the disk removal, while Konjetzny and von Staplemohr prefer to fold the disk anteriorly. These practices are opposite approaches to a result, which, at best, is limited to an improvement in the conscious and observable joint symptoms. If, as all agree, the pathogenesis of the joint disease includes an atrophic degeneration of the inter-articular disk, the disk folding is compensatory, while the disk removal merely advances the disease process. The folding operation interposes an additional anterior barrier of limitation of condylar movement. This is probably temporary because of the persistence of the causative factors; and is contraindicated because it removes the posterior portion of the disk, which is a shock absorber of occlusal stress in the protection of the vital structures concerned in the reflex symptoms.

The removal of the disk has been recommended by Axhausen for the treatment of joint symptoms, because it controls condylar movement by deepening the mandibular fossa. Anatomic and roentgenologic research demonstrated that the joint disease includes a posterior-superior displacement of the condyle, atrophy of the disk and a deepening of the mandibular fossa. It is therefore obvious that the disk removal at once advances the disease process to its full maturity and renders the patient more susceptible to reflex symptoms.

A comparison of the symptoms of deafness, tinnitus and vertigo with crackling noises and traumatic joint movements demonstrates the inadvisability of these radical procedures.

In addition to these objections, the

surgical treatment of mandibular joint symptoms is not advised because of the difficulty of access to the joint, and the nerve injury which accompanies these procedures. Konjetzny reported five cases of facial paralysis as sequelae of twelve operations; while Axhausen, modifying the joint approach, reported two cases of facial paralysis in ten operations. While Axhausen's approach to the mandibular joint by excision of the pinna of the ear reduced the incidence of facial palsy, his report showed that this procedure was complicated by grave disturbances of the external auditory canal.

The treatments which inject substances into the joint and which irritate the synovial membrane by means of a sterile needle probably relieve joint symptoms by causing a thickening of the cartilages as a response to the irritants. Redfern's animal experiments which showed that chemical irritants produced ankylosis of the joints are convincing evidence against medicinal injections. The irritating effect of a needle, while probably the least harmful phase of the symptomatic treatments, involves the possibility of joint infections which cause more serious joint disease.

The policy of exercising the defective joint, or the joint recently operated on, which seems to be universally practiced by workers in this field, is also highly questionable. Exercise of the abnormal joint is contraindicated on the basis of the experimental research of Redfern, and of Phelps and the practical research which I have done on this subject.

Phelps said, "The importance of rest has been demonstrated in the treatment of wounds, and inflamed organs and tissues, and therefore, rest rather than motion is indicated in the treatment of inflamed joints." Redfern, in connection with the treatment for diseases of articular cartilage, said:

> It is very obvious that whenever the cartilages of a joint have lost their smooth surfaces, perfect rest is essential for a cure, and it should be secured by bandaging or by splints. This is equally essential when ankylosis is expected, for nothing can be conceived so likely to produce destructive irritation as the moving of two roughened and highly sensitive surfaces upon each other; nor is anything so likely to prevent the organization of lymph, which may be expected to be poured out in this stage of the disease.

In the treatment of cases in conjunction with this research, I have found that, while indicated, rest of the mandibular joint presents a complex problem. Rest is not possible through bandaging of the joint, if the latter is abnormal. The contraction of the muscles attached to the mandible during swallowing and in attempting to talk results in a movement of the deformed articular surfaces on each other and further traumatizes the articular cartilage. Rest of the mandibular articulation is dependent on the establishment of normal joint relationships and the correction of occlusal trauma.

Therefore, a treatment which may be applied to all cases must be based upon the fundamental rule of therapy which is the neutralization or correction of the cause. This makes differential diagnosis of the joint disease the determining factor in the type of treatment. I have shown the principal causes of mandibular joint diseases to be bite anomalies, tooth destruction, disequilibration of the masticating stresses, inflammatory processes about the teeth and jaws and systemic involvements. The most potent and prevalent factors are bite anomalies associated with loss of teeth and malocclusion.

The treatment of these cases consists of the application of orthopedic principles to the problems of dentistry. There are, in this type of case, displacements of the mandible which are reflected in alterations of either or both mandibular joints.

The greatest amount of alteration occurs in the upper or gliding portion of the joint. The technic of repositioning is therefore primarily concerned with this movement and the success of the treatment is dependent on this phase of the technic. The bite should be corrected by the method which most quickly reestablishes normal articular relationships. Gradual bite adjustment has proved to be unsatisfactory in my work.

I have found that patients become more easily adjusted to the normal relationships than to a series of gradations of the abnormal. The adjusted position is effected on the Wadsworth articulator with models of the teeth which have been mounted by means of facebow and T-piece transfer. This position is established by the construction of temporary bite planes, which are attached to the teeth or rested on the gums. The occlusal surfaces of these planes should be smooth segments of the patient's dental curve, according to Kirk's datum.[11] The latter feature is an essential in this treatment, because it not only is an aid in accustoming the patient to the newly established position; but has the additional advantage of placing a minimum of untraumatic stress on the functioning joint. The smooth planes may have self-centering devices, such as countersunk ridges or pyramids. They may also be utilized for tooth moving devices or interdental elastics. These features depend on the case requirements.

When the normal mandibular position has become habitual, the temporary planes are reproduced by permanent replacements. The permanent reconstructions and replacements are accurate occlusal duplicates of the temporary bite planes, with the exception that intercuspal relationships replace the self-centering devices. These are constructed singly, and with each reconstruction, the bite planes are cut off for the extent of the replacements. The types of prostheses, whether gold or porcelain, fixed or removable, are matters which may be left to personal preference.

The ages of the patients treated by this technic, which I have termed "gnathic orthomorphosis,"[12] range from 4 to 62 years. Six patients with pyorrhea profited by the balancing of the masticating stresses, while in a great majority of cases the treatment was coincidental with tooth replacement.

Gnathic orthomorphosis is not dependent on the state or presence of teeth, nor on the age of the patient.

Anatomic evidence of the value of this technic is offered in consideration of the joint results of repositioning the mandible as illustrated in Figure 11. This specimen represents a self-corrected intermaxillary relationship in compensation for missing teeth. The lower first molar is in edge-to-edge occlusion with the upper bicuspids. Figure 1 demonstrates that this mandibular articulation is normal, with the favorable exception of an increased space on the posterior aspect of the condyle and the more vertical relationship of the masseter muscle attachments.

There are some cases with mandibular joint symptoms without occlusal anomalies and some wherein the joint symptoms persist after gnathic orthomorphosis. They may be caused by inflammatory conditions of the teeth, the peridental tissue and the jaws, focal infection and systemic disease. The inflammatory processes and focal infection are caused by

11. Kirk, E. C.: D. Cosmos, 71:297 (March) 1929; 72:631 (June) 1930.

12. Orthomorphia is a medical term defined as the surgical and mechanical correction of deformities. Gnathic orthomorphosis is defined as the mechanical correction of abnormalities of the masticating mechanism.

partial eruption or impaction of teeth, gum trauma, periapical disturbance, caries, occlusal trauma, impaction of filling material and the presence of ill-fitting crowns and bridgework. The treatment of these cases is the eradication of the cause. When the joint symptoms are caused by systemic disease, other joints are also involved. The dental treatment in these cases is limited to the resting of the mandibular joints.

If abnormal joints and occlusal anomalies are present in a case which requires surgical care about the teeth or jaws, it is advisable to reposition the mandible before the operation in order to minimize the damage to the joints resulting from the trismus which may be subsequent to the surgical work. Trismus is caused by muscle contracture secondary to inflammation. Rest is preferable to exercise in this condition because of the danger of traumatic injury resulting from the forced joint movements coincidental with the accepted practices of extending the opening movements of the jaws. If local treatment necessitates forceful opening of the jaws, this procedure is excusable. Otherwise, we should reassure the patient and recommend the application of compresses or gentle massage of the masseter muscle and the mandibular joint, and the use of a warm mouth wash without any conscious attempt to open the jaws.

I have treated three cases of ankylosis. One case was a complete ankylosis, complicated by a systemic arthritis deformans, and two were partially ankylosed. The first patient discontinued treatment. The partially ankylosed joints were corrected by repositioning the mandible, the elimination of dental infection, occlusal adjustment and therapeutic rest. In one of these two cases, permanent bite adjustment necessitated occlusal reconstruction. In the other, the extraction of three infected teeth, namely, the upper left second bicuspid, the lower right first molar and the lower left third molar, exacerbated the joint symptoms. With the healing of the tooth sockets, the ankylosis gradually improved, without any conscious attempts to overcome the limited movements. The removal of these teeth permitted an improved occlusion, which with grinding adjustment is now normal in all respects, as are the joint movements.

The results of these cases show that the causative factor in the first was primarily the bite anomaly; while, in the second, the predisposing and exciting causes were the infected teeth and their poorly occluded restorations. I do not consider my experience with ankylosis to be sufficient to formulate a treatment. The important facts in this phase of joint disease are that the ankylosis is a sequel of an early joint disease and that exercise, surgical procedures, infection and chemical and mechanical irritation of the abnormal joint are predisposing factors in the calcification of the articular cartilage which accompanies complete ankylosis. These factors emphasize the need for the recognition and correct treatment of the early symptoms of abnormality of the mandibular articulation.

CONCLUSION

That the treatment of abnormalities of the mandibular articulation has been symptomatic is evident. A fuller understanding of their etiology, presented herewith, is the basis of the treatment which I have found to be most satisfactory in these conditions.

Their early recognition and treatment are essential in the prevention and treatment of ear, speech and personality disturbances. These symptoms have long been a challenge to medicine and psychology. Their etiology is too complex to be

explained in terms of condylar impingement on the auditory canal and the tympanic plate. The etiologic contributions of mandibular joint disease are an infinitely more important group of factors, which include disease of the articular disk, cartilage, and bone, a reflex neurosis of the auriculotemporal nerve and the involvement of infection and systemic disease.

The results have been made possible by the integration of the medical, psychologic and dental phases of this research.

Medical Arts Building.

PROGRESS OF DENTISTRY*

By HOWARD W. HAGGARD, M.D., New Haven, Conn.

YOU have all seen the preliminary program for this dental congress and you have noticed on the front cover two small pictures, one showing a dentist of three or four centuries ago (a famous oil painting), the other, a dentist of today. The things that catch the eye in these two representations are the surroundings, the costumes, the equipment. The dentist of the sixteenth or seventeenth century is shown in shabby leather clothing in an out-of-doors scene, on a platform. He is extracting a tooth. I have no doubt that he is employing for this extraction the famous instrument known as a pelican, which, if time ever permits the research, I hope to establish as the precursor of the modern Stilson wrench used by plumbers. It was the instrument which the great surgeon of the sixteenth century, Ambroise Parè, whom I shall mention in a moment, said always got the tooth sought for, but in the hands of the dentists of those days it usually got as well the teeth on both sides of that one and at least one in the opposite jaw.

This pelican, a probe perhaps, a knife and a cautery wire to stop bleeding, made up the complete dental equipment of this sixteenth-seventeenth century dentist. His knife, I may add, was usually his dagger, used impartially in his professional work, in his squabbles, in his eating, and finally to pick his own teeth after meals. It was honed at intervals on the top of his leather boot. The lady with this dentist is not a dental hygienist, and as employed here it is her duty to extract money from the patient's pocket while the dentist extracts his teeth.

Turning from this picture to that of the modern dentist, we find a tile-floored room, a white-gowned dentist, a freshly marcelled dental hygienist, a dental engine, a modestly tinted expectoration basin, an x-ray outfit, and rows and rows of drawers containing, as we know, the seemingly endless array of dental instruments.

These are things that catch the eye—the surroundings of these two men. We think that we read progress in change of equipment—and progress is there, but it is not the real progress. These things are useful accessories, needed tools of the profession, but while they attract our attention, they are not dentistry. You

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know and I know that the finest equipment that the dental supply houses are able to provide cannot of itself make a good dentist.

In spite of apparent differences in these two pictures, the real difference does not show. That real difference is something intangible. It is in the man who is the dentist: it is in his knowledge, his understanding, his attitude, and it is in the regard in which he holds his profession and, in turn, the light in which it is regarded by the public. These are things that no artist can paint. We could take that tinkering dentist of the sixteenth century, a mountebank, as like as not a purse snatcher, a roisterer in inns, a man who knew nothing of dentistry except extraction and the opening of gumboils—we could, I say, give him a hair cut, a bath, dress him in the costume shown in the picture of the modern dentist, put him against a background of shiny instruments and marcelled dental hygienists, and neither you nor I from merely looking at him could detect the deception.

The real progress of dentistry, the thing that makes the true difference between the tinkerer of 300 years ago and the dentist of today is invisible. And it is of that very invisible thing that I am going to speak.

I have been asked to talk on the relation between medical progress and dental progress, to point out briefly how medical discoveries have added to dental advantage, and although I was not asked to do so, I shall in turn point out the dental advances which have added to medical advantage.

For just a moment let us go back some centuries—not to detail in monotonous historical sequence the minutiae of primitive and ancient dental technic, but merely to form a background for the real story of dental progress. The obvious procedures — stopping cavities with metal, wiring in carved false teeth, and extraction—are present in antiquity. Brushing the teeth likewise has its place there in spite of the often and naive belief that toothbrushing is a modern development. The ancients — some of them at least—brushed their teeth in the laudable desire to keep them clean; the moderns more often brush their teeth as a reluctant duty in the belief that they are keeping them free from cavities. There is, of course, a history of dental mutilation—the coloring of the teeth, the filing of them into grotesque shapes, the setting of them with jewels, and even in recent times the desire for a mouth full of gold crowns. But these matters turned solely on beliefs concerning personal adornment. It is a very fortunate fact that mutilated teeth as personal adornment are the exception rather than the rule of human desire; in most ages and among most people, sound white teeth have been the ideal of beauty. Ancient dentistry, with one exception, turned on the question of beauty. The ancients stopped their teeth, brushed them, wired in false teeth and made them look whole and normal for precisely the same reason that the cannibal followed a different procedure, i. e., filed his teeth—both were conceptions of personal adornment. The primary dental interest, then, of the ancients was beauty. And in catering to this beauty, the occupation of the dentist was on a par with that of the perfumer, the hair dresser, the bath attendant. More often than not, he served simultaneously in all of these various capacities.

The only possible medical relation held by the ancient dentist was one that centered around pain—toothache. For

a preventive, he promulgated the ancient household remedies, eating a mouse once a month—I presume with the skin on—and fumigating the tooth with the smoke from onion seeds to drive out the worms that were supposed to cause the toothache. The natural lack of success with these prophylactic measures drove the ancient dentist to surgery—the surgery of extraction, brutal extraction, but, mind you, not extraction to remove abscessed roots from the jaw but simply to stop pain. If the pain stopped of itself, the extraction was not carried out.

The aims *in toto* of ancient dentistry were the preservation of beauty and the prevention of pain. I emphasize that fact for it forms nearly the whole theme of the history of dentistry—dentistry for the preservation of beauty and the prevention of pain—down to less than a hundred years ago, when the aim of dentistry underwent a radical change, modern dentistry came into being and there developed that change in intangibles which I have mentioned.

I said a moment ago that dentistry in ancient times was a branch of surgery, and this was true also in medieval times and in the Renaissance, the period in which the dentist on the front of your programs lived. We look today upon surgery as a respectable profession—most eminent and respectable. But, like the alteration in dentistry, this change in surgery is very modern. Back in the days when our dentist of the leather clothes carried out his occupation as a side line to general knavery, the surgeon was not a respectable citizen; the calling of operative surgery was followed only by men of low station. The surgeon like the dentist had nothing to offer except a technic. He amputated legs, opened abscesses, treated wounds and occasionally cut for the stone. That was about the limit of surgical practice. The dentist extracted teeth, and as often as not the occupations of surgery and dentistry were combined. A logical combination. And by an equally logical extension, the surgeon-dentist was also a barber. He who was skilled in cutting off legs and arms and pulling teeth was also skilled in cutting hair. As I say, a logical combination, but, as we look at it now, hardly a dignified one. You see, there has been a very great change. I should be willing to trust a great surgeon with the interior of my abdomen, but not with the hair on my head. I do not say this facetiously, but to illustrate the change that has come over surgery in becoming a science for the correction of bodily derangements. The surgeon no longer caters solely to the personal adornment of his patient, and the same is true of the dentist. His aims are no longer confined to the preservation of beauty and the prevention of pain. In bringing science to the treatment of the teeth, he has taken his stand as a practitioner of medicine.

It is my purpose here to analyze the forces which have brought about this profound change; and always we must bear in mind that the dentistry, the medicine, the surgery of today is not at an end. We always tend to look at things that way, you know, and believe that we have achieved the ultimate or nearly the ultimate—to do so is a sign that we are personally getting old and don't like change. We rationalize our desires for stability, our opposition to innovations into a convenient and satisfying belief. But medical subjects are as much in transition now as they were fifty years ago. The dentistry of fifty years hence may be as different from that of today, and probably will be, as was the dentistry of half a century ago.

Now in analyzing dental progress, let us start with a period of just about 200-250 years ago. That would take us into the time when Louis XIV ruled over France, when Charles II and then William and Mary and finally George I were on the throne of England, when the Turks made their last attack on Vienna, the time that New Amsterdam became British by treaty and was renamed New York, and about the time that there lived two men who were most important in giving to dentistry the initial impetus to its modern progress. The first of these men was Pierre Fauchard of France, who in 1728 published his book "The Surgeon Dentist." The other, who was born this same year, was John Hunter, the surgeon who about forty years later was to write a classic called the "Natural History of the Teeth."

Now in this period when Louis XIV, the Grand Monarch of France, held court, a magnificent spectacle was presented: grand dames in gorgeous costumes; gentlemen bejewelled, beriboned, with satin hose and velvet breeches, and gold encrusted swords. But when we know the medical conditions of the period, sometimes this scene, this setting, these costumes fade away; we see reality, and in that reality, our vision of those fair skins fades, and we see them as they really were—pocked-marked and blemished. And those smiling lips made famous in portraiture often opened on inflamed gums edged with pus, on blackened, broken teeth, or on carved ivory teeth crudely held in with wires. Louis himself had pyorrhea very severely; he had numerous abscesses in his jaws; his teeth decayed until nothing was left but snag roots: a very different picture indeed from the one we are accustomed to associate with his magnificence, but one which more truly characterizes the time.

The dentistry of this period was nearly as crude as it was in the period in which the rascal portrayed upon the cover of your programs practiced. (I mean, of course, the upper picture.) In the eighteenth century, the dentist with few exceptions was a mountebank or an itinerant tinker who practiced dentistry as a side line to fortune telling and the sale of love philters; or he was a public servant, the bathhouse keeper, let us say, or else he was a barber-surgeon, and that was little better, for surgery was not yet a respectable occupation. One of the few exceptions was Pierre Fauchard. It is his book which contains the first account of pyorrhea. He was also the first to employ orthodontic procedures in the treatment of severe malocclusion. But Pierre Fauchard did not know the anatomy of the teeth, did not know it, that is, to the extent of being aware of the significance of the pulp cavity, the enamel, the dentin, the nerves. Pierre Fauchard was for his time a high-grade technician, to whom patients came solely for the purpose of preventing pain and preserving beauty. His efforts at orthodontia—very crude indeed they would seem now—were intended to correct deformity with an eye only to beauty.

I am trying to characterize dentistry of this period, the period from which we really start to progress. Perhaps I can do so best by reading a tooth paste advertisement that appeared in the *British Journal* the same year that Fauchard's book appeared in France. Let me say parenthetically that less progress has been made in advertising dentifrices than in dentistry. The modernized version of this ancient advertisement can be heard almost any day over the radio. Under date of 1728 it reads:

The Incomparable Powder for cleaning the teeth which has given so great satisfac-

tion to most of the Nobility and Gentry in England for 20 years. Once used it makes the teeth as white as ivory, never black or yellow; and effectually prevents them from rotting or decaying, continuing them sound to exceeding old age. It wonderfully cures the scurvy in the gums, prevents rheum or defluxion, kills worms at the roots of the teeth, and thereby hinders the toothache. It admirably fastens in loose teeth, being a neat, clean medicine, of a pleasant and grateful scent.

One almost expects to hear the inevitable "and see your dentist twice a year." But advice was unnecessary then, for there was no need of recourse to the dentist if you used Mr. Markam's incomparable powder.

I have said some very unpleasant things about our surgical and dental ancestors of 200-250 years ago. And I pause for just a moment to see what was available in medicine in these years, the beginning of the eighteenth century. What was there? A little knowledge of anatomy, gross anatomy. Harvey had discovered the circulation of the blood, but no one had even the vaguest ideas yet as to why man breathed. The microscope had come into use, and certain facts had accumulated concerning histology. Quinine was employed—employed, in fact, for almost all febrile states. There was essentially no pathology. There was also no knowledge of bacteria or of the principles of infection. Ambroise Paré had developed the technic of surgery—but it was a surgery without anesthesia, without antisepsis or asepsis, a surgery without knowledge of pathology and one limited to operations on the surface of the body. The practice of internal medicine was more or less a respectable occupation but rarely a beneficial one. Quackery was rampant. And so also were diseases, to an extent almost incomprehensible today.

It was in this field, then, that there came the second great character of eighteenth century dentistry, John Hunter, of England. He originated surgical pathology. He found surgery a mechanical trade and he left it a science. What he did for the social status of the surgeon is illustrated by a remark of one of his fellow-surgeons: "He, John Hunter, alone made us gentlemen." In short, he made something more of surgery than the mere clipping off of legs and beards; he gave it dignity, because the surgeon from thence on was a man who studied pathologic conditions and corrected them. Technic, manual and mechanical efforts, became subordinated to intellectual skill in diagnosis and surgical procedure. The surgeon moved from the position of a mechanic to that of a professional man.

This change affected dentistry, for John Hunter included dentistry as a branch of surgery, and he wrote, as I have said, the "Natural History of the Teeth," describing their anatomy and their pathology.

I do not mean that he gave us these things fully formed and complete; there was much indeed that no man in Hunter's time knew. He, for instance, was an advocate of the now discarded practice of tooth transplantation. Rowlandson, the caricaturist of the eighteenth and early nineteenth centuries, has left an amazing drawing showing the operation of transplantation. There in a room is a dentist with a villainous looking pair of forceps. As patients, there are a number of the gentry, obviously some who have overlooked Mr. Markam's tooth powder, admiring their new teeth in mirrors. And there are certain poor youngsters there whose cruel parents have sold the young teeth which have been extracted and implanted into the vacant sockets of the gentry.

The important aspect of Hunter's work is this: Dentistry as it came to him,

save for Fauchard's work and that of the German, Philipp Pfaff, was solely a mechanical trade; he developed a wholly new conception of it as a science, one requiring intellectual skill in diagnosis and in choice of surgical procedure. In other words, he did for dentistry just what he had done for surgery.

The mechanical aspects, of course, persisted and grew and have developed enormously. But it is the professional aspect that we are concerned with, for it expresses the real and basic progress of dentistry. And there is another aspect which goes with it: public regard. And I say to you what you already know, that the regard in which your profession or any calling is held at any time is precisely a reflection of the regard in which the men of that profession hold it. When dentists were solely technicians, solely merchants, they regarded their trade in that light and they received the public kudos accruing to locksmiths, surgeons and barbers. But when they viewed it in the light in which John Hunter had shown it, their regard for themselves changed and the regard of the public began to change correspondingly.

But this alteration did not take place at once. The public were less well acquainted with John Hunter's work than were the few dentists who undertook to follow it. To most of the public, the aims of dentistry were still merely the preservation of beauty and the prevention of pain. And I must admit that the dentists of the early nineteenth century were not loath to publicize this view.

With this point in mind, I take you for a moment to the period midway between our time and that of Fauchard's, about 100 years ago. There were still no schools of dentistry. The dentist learned his trade and his profession by apprenticeship to older dentists. But a sense of dignity—the spark kindled by Hunter—appears as a keen desire for cooperative advancement. To serve this interest, there is founded a journal of dentistry. Its first volume was published in 1839 in New York City, the *American Journal of Dental Science,* and that first year the work of John Hunter, "The Natural History of the Teeth," was published in its columns. But the contribution that supports my point, that is, that the aim of the dentist and the interest of the public were primarily in the preservation of beauty and the prevention of pain, is this: There appeared in the journal, along with Hunter's classic, a poem which has its place in dental history, for it marks the first serious attempt to popularize dentistry by pointing out the importance of conserving the teeth. This education of the public by the dentist has continued from that day onward. It is an important aspect of the services which he renders. But 100 years ago, the date commemorated by the Century of Progress Exposition, the efforts of the dentist were decidedly different from the amazing exhibits shown now in Chicago.

You have seen or heard of the exhibits here. Certainly they are not devoted to preaching solely the preservation of beauty until the youth or maiden marries, or the avoidance of pain. They preach and preach vigorously the thing that has made dentistry a great science, a great profession, the preservation of health and the prevention of disease.

But let me read a few lines from the most dignified efforts to publicize dentistry of 100 years ago. The poem "Dentologia" was written by Solyman Brown, A.M. It is lengthy and appears with "notes, practical, historical, illustrative, and explanatory by one Eleazar Parmly, dentist."

Robbed by neglect, of symmetry and grace:
Behold those organs formed on nature's plan,
To serve important purposes to man;
To form the sounds in which his thoughts are drest,
His wishes uttered and his love confest;
To fit his solid food of every name,
For healthy action on the general frame;
Behold these organs, wrested by abuse,
From wisest purpose, and from noblest use,
Deranged, displaced, distorted, set awry,
Disgusting objects of deformity!

But learn the remedy—the dentist's skill
Subjects disordered nature to his will.

A little later in the poem, the author, with all of the anticlimactic effect of a modern advertising agency promoting a mouth wash, devoted four stanzas to describing the alluring beauty of a young lady named Urilla, "nature's favored child." And then Urilla opens her mouth to speak:

And lo, the heavenly spell forever broke;
The favored angel vanished into air,
And left unfortunate Urilla there:
For when her parted lips disclosed to view,
Those ruined arches, veiled in ebon hue,
Where love had sought to feast the ravished sight
On orient gems reflecting snowy light,
Hope, disappointed, silently retired,
Disgust triumphant came, and love expired!

Isn't that poem, which goes on stanza after stanza, enough to frighten any young lady of the early nineteenth century into a trip to the dentist? One can almost see a dentist of those days, with a patient in the kitchen chair that was used for the work, a mouth full of files and wire and rags (I speak of the early nineteenth century), and gagged beyond reply (I include the twentieth century), the dentist treading the boards of that office, the *American Journal of Dental Science* in hand, and with appropriate gestures declaiming of Urilla.

The juxtaposition of John Hunter's masterpiece and Solymon Brown's "Dentologia" in that early journal typifies more than any amount of description the character of early nineteenth century dentistry: sound science and an intellectual calling on the one hand; the sentimental and ancient appeal for preservation of beauty on the other. It was the transitional state in dentistry.

Now in the progress from this point on, I do not intend to deal at all with the technical aspects of dentistry: porcelain teeth, the dental engine, all of the minutiae of a mechanical art, which, by the way, as you know, have been almost wholly of American origin. These things bear the same relation to dentistry that the scalpel, the scissors, the adhesive tape, the operating table and the catgut do to surgery. They are important—yes; but vital—no. The hand that wields them, and above all the brain that guides that hand—those are the important things.

In the nineteenth century, dentistry blended with medicine. The purposes of the two fields became a common purpose: health—preservation of health and prevention of disease. Dentistry profited by every advance of medicine. The discoveries that have given us modern dentistry in concept and in practice have likewise given us modern medicine in concept and in practice.

In the first forty years of that nineteenth century, there was little progress in medicine; but in the fifth decade, a great practical step forward was made. And I have no hesitation in saying that that step, which came essentially from dentistry to medicine, pays back every debt that dentistry owes or ever can owe to medical discovery. I refer to the introduction of anesthesia. It is an often repeated story, but I want to speak of an aspect of it that is not commonly known. You are familiar with the fact that Crawford Long of Georgia was unquestionably the first man to employ ether anesthesia. But his use of it for a minor

surgical operation in 1842 in a town 100 miles from a railroad did not in any way advance the use of anesthesia. He has the priority, but no credit for the useful application of anesthesia. You are familiar with the fact also that William Morton, in 1846, demonstrated the use of ether at a surgical operation at the Massachusetts General Hospital in Boston and started the era of anesthesia. You are probably familiar with the fact that, somewhere in between, there was a dentist named Horace Wells, who came from Hartford, Conn. The fact of the matter is that Horace Wells was the inspiration for Morton's demonstration. Quite recently, there has come to light certain evidence which shows especially clearly his part in the proceedings. Let me tell the story as it occurred.

The time is 1844, a period when, from our point of view, there was little in the way of general entertainment. There were no moving pictures; the theater was not extensively organized; there was no radio; there were no automobiles, and there was no great flood of books and magazines and newspapers. But it was a time when lecturers were in their zenith, especially lecturers on educational matters. The attending public wished to be instructed as well as amused.

For the evening, then, of Dec. 10, 1844, a certain Mr. Colton, popular lecturer on scientific subjects, had engaged a hall in Hartford. In the *Connecticut Courant,* he published an advertisement, from which I read extracts.

A GRAND EXHIBITION of the effects produced by inhaling NITROUS OXIDE, EXHILARATING or LAUGHING GAS! will be given at UNION HALL, THIS (Tuesday) EVENING, Dec. 10th, 1844.

Forty Gallons of Gas will be prepared and administered to all in the audience who desire to inhale it.

Twelve Young Men have volunteered to inhale the Gas, to commence the entertainment.

Eight Strong Men are engaged to occupy the front seats, to protect those under the influence of the Gas from injuring themselves or others. This course is adopted that no apprehension of danger may be entertained. Probably no one will attempt to fight.

The Effect of the Gas is to make those who inhale it either Laugh, Sing, Dance, Speak, or Fight, &c., &c., according to the leading trait of their character. They seem to retain consciousness enough to not say or do that which they would have occasion to regret.

N. B. The Gas will be administered only to gentlemen of the first respectability. The object is to make the entertainment in every respect a genteel affair.

Those who inhale the Gas once, are always anxious to inhale it the second time. There is not an exception to this rule.

No language can describe the delightful sensation produced. Robert Southey, (poet) once said that "the atmosphere of the highest of all possible heavens must be composed of this Gas."

Mr. Colton will give a private entertainment to those Ladies who desire to inhale the Gas, Tuesday, between 12 and 1 o'clock, FREE. None but Ladies will be admitted.

Entertainment to commence at 7 o'clock. Tickets 25 cents.

Horace Wells, a dentist of Hartford, attended this meeting. With him was a friend, and this friend decided to go up on the platform and inhale the gas offered by Colton.

It so happened that when the leading traits of this gentleman's character were laid bare by the gas that he inhaled, he wished not to laugh or sing or dance, but to fight. He looked down upon the eight strong men occupying the front seats. From among them, he selected the one who appeared the strongest and made a dive for him. The strong man responded by rushing up the aisle. Close behind him came the gas intoxicated friend of Wells. Up the aisle, across the back of

the hall and down the other aisle, to the front came the pair. The audience rose and cheered. A few ladies, true to the tradition of the day, swooned gracefully into strong arms.

Near the front of the hall, Wells' friend, outdistanced by Colton's guardsman, undertook to make a short cut. He jumped across the back of a bench, misjudged the height, caught his leg on the bench back and fell sprawling in the aisle. The shock restored his scattered senses. He arose, brushed off his clothing, and slid into his seat beside Wells. Colton brought the audience to order.

Wells watched his friend beside him with amused interest, which changed to amazement as the friend leaned forward, pulled up his trouser leg, and exposed a gaping wound from which the blood flowed freely. He asked Wells how he had been hurt. Wells questioned him and elicited the fact that he had been utterly unconscious of pain when he struck against the back of the bench over which he had fallen.

A great idea grew in the mind of Wells—an inspiration. The next day he gathered some friends in the profession. He prepared nitrous oxide. The gas was administered to him, and while Wells was under its influence, a molar was extracted by a dentist named Riggs. Wells felt no severe pain.

Horace Wells realized that he held the possibilities of a great beneficent discovery, for these were the days when people refused extraction because of the pain; and these were the days when jaws were filled with rotted roots, the days when rheumatism was almost universal in those past middle age. His discovery was important in dentistry, but he envisaged a broader field, for these again were the days (so recent a time as the middle of the last century) when all surgical operations were performed without anesthesia. There was horrible suffering. The patient was held down, tied down. The surgeon in the interest of humanity, but to the detriment of his handiwork, carried out his operation with almost incredible speed; he was a veritable sleight-of-hand artist.

Wells, as I say, saw the possibilities of relieving the pain of surgical operation. He went to the most prominent surgical center of the east, Boston, to the Massachusetts General Hospital, and offered to demonstrate his method. He was given a medical student with a toothache. He tried with his crude apparatus to administer the gas and at the same time extract the tooth. The procedure was a failure. Wells, in disappointment, returned to Hartford, where he published a statement of his belief in the possibilities of surgical anesthesia.

Wells failed, as I say, to demonstrate the practicability of anesthesia, but his efforts inspired William Morton, of Carlton, Mass., a dentist and also student of medicine at Harvard, and one time an associate of Wells. Morton directly took up the work that Wells had commenced; but it was solely Wells' inspiration that started him on the search for some substitute for nitrous oxide, a search that as you know ended in the use of ether and that culminated in the dramatic demonstration in 1846 of successful surgical anesthesia.

Now I have gone to great length in speaking of this subject of anesthesia; for essentially it is the first practical discovery in the medical fields made in the nineteenth century. It is dentistry's greatest contribution to medical progress, and it is one of the most beneficent and humane discoveries ever made. But frankly the introduction of anesthesia did not of itself raise dentistry to its eminent position, one on a parallel with medicine in the great purpose of

preserving health and preventing disease.

I pass now over many minor discoveries, many technical improvements, to come to the period of the greatest discovery perhaps ever made by man, one that came late in a century and which has meant for us more medical progress than was made in all the centuries that preceded it. I refer to that discovery upon which preventive medicine is founded, the one which gave us sanitation and antisepsis and asepsis, the one from which in effect date modern medicine, modern surgery and modern dentistry.

In a time such as the present when the fact that infection is caused by parasitic bacteria and protozoa has so thoroughly permeated the general knowledge as to be the commonplace information of the school child, it is difficult to realize that only sixty years ago this fact was not within the information of even the physician or the surgeon or the dentist. He knew literally nothing of the cause of infection or of its consequences, although those consequences were before him constantly. Imagine a man of today seeing pus in a wound or in an abscessed tooth and expressing satisfaction because he believed that pus formation was a regular and necessary part of the healing process. Men believed such things sixty years ago, and sixty years is not a time remote but one well within the memory of men living today.

I say that the physician, the surgeon, the dentist of sixty years ago saw before them the consequences of infection, but did not recognize them for what they were. And we should not have derision but sympathy, great sympathy, for those men; for, undoubtedly, we today in other matters stand in the same position that they stood in. Unquestionably, many of the conditions, abnormalities, diseases that we accept as almost inevitable will yield to the progress of coming generations. Then they, looking back even as we look back, will see that the explanation was before us all the time and that we were merely blind. After all, we see only what is pointed out to us. Before our eyes today, there are without doubt discoveries to be made, as yet unrecognized, unheralded, which will revolutionize medicine and dentistry as completely as did the bacterial conception of infection. When that famous group of men: an obstetrician, Semmelweiss, a chemist, Pasteur, a surgeon, Lister, a physician, Koch, and a dentist, Miller, pointed out what infection was, then we saw, and, in seeing, profited.

Look to your own field, dentistry, and see what a difference it made. At a time, as I have said, within the memory of men living today, the accepted belief was that dental caries was due to the action of worms, was a natural corrosion, was due to age. All sorts of explanations were made, but every one of them made of caries a strictly local condition with no connection with the remainder of the body except through the very obvious functions of mastication and vocalization and the ever pressing view to beauty. But when Prof. Willoughby Dayton Miller, an American working in Berlin, showed that caries was due to bacterial action, dentistry ceased to be a local caring for the teeth, a reparative action, and became something vastly different. Infection is a phenomenon to which all the tissues of the body are subject. Thus, a tie was formed, inseparably connecting dental practice with surgical and medical practice. They became united in a common interest, and that interest, as I have said before, was the preservation of health and the prevention of disease. Upon this point the three converged and henceforth became one.

I was asked to speak on medical prog-

ress, especially in its bearing on dental progress. That I could do in matters of a hundred years or more ago when medicine and dentistry were different. The only difficulty lay in the fact that no great progress was being made in either field. Of today, I cannot tell of the bearing of medical progress on dental progress, for medical progress is dental progress and dental progress is medical progress. The two are no longer distinct: they are divisions of the same great field, with common interests.

And the newer things in medicine—hardly with exception they are as much dental as medical. In some things, even, the lead has been turned the other way. The keynote of this century is organized prevention. And nowhere, in no field, has prevention, personal prevention, been so effectively carried out as in dentistry. The dentist has progressed amazingly in training the public to recognize the necessity for periodic inspection. The physician is struggling, and as yet not successfully, to impart a similar recognition of a similar necessity in his field.

Now, for one moment only, to go back to the pictures on the front of your programs, the pictures I mentioned in the beginning of this talk, the one showing the dentist of 300 or 400 years ago and the one showing the dentist of today. Transpose them. Strip off that leather garment of the mountebank; put him in the white gown of the modern man, and you have no dentist; stand him in the surroundings of a modern dental operating room; train him even in the use of the instruments there, and still you have no dentist as we know the dentist. It is not the tangible things, but the things that we call conceptions that make the difference—what dentistry stands for, what its aims and ideals are, what its service is, what its contributions are. Those are the things that have made dental progress. They are the real difference between the two pictures on the covers of your programs. But we can't see them there—they are invisible—intangible.

GENERAL EXODONTIA PROCEDURE*

By FRANK W. ROUNDS, D.D.S., F.A.C.D., Boston, Mass.

ADVANCEMENT in the status of the specialty of exodontia has been rapid in view of years. Among the factors in this advancement may be enumerated the improved educational background of the younger men in the profession, which has stimulated a deeper knowledge of the fundamental sciences, including chemistry, bacteriology, pathology and radiology. This broad foundation has, in turn, fostered a more intensive application of this knowledge to the study of anesthesia, the relationship of teeth to health, the necessity of rigid adherence to sound surgical principles and the ability to employ laboratory and roentgenographic findings as diagnostic aids.

The insistence of the laity on expert service and the economic urge are also

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potent factors; for the public at large, through the educational influences of health campaigns as promulgated by the press, the radio and other sources, is making an increasing demand for the highest qualifications in its consultants. The old law of the "survival of the fittest" has contributed much to this development.

These advances could not have been made with so much satisfaction had not dentistry fostered organization. Subsidiary societies definitely relating to the specialty have made possible interchange of thought among their representative members and also the many technical changes, which are thereby becoming more standardized. Thus, the specialist, in turn, transmits advanced ideas to his confrères and the wheel of progress keeps on revolving, opportunities for service to patients, and for the betterment of the profession at large, thereby increasing.

Every dentist must, at one time or another, face the necessity for extraction. Some prefer or, owing to location, are compelled, to perform all exodontia operations. Some operate only in those cases presenting no complications, and many, because temperamentally disinclined, incapable through lack of training or not desiring to face such problems, refer all surgical procedure to the specialist. The only consideration in every instance should be the patient's interest and an honest application of the "Golden Rule." In some instances, the dentist finds that he has underestimated the difficulties to be overcome and the operation becomes a failure. He then finds it necessary to refer the case for completion. Is it not wiser, in such a situation, to refer the case in the beginning, since the reaction on the part of the patient is not always a pleasant one? Inevitably comparisons are made, although, I feel sure, the specialist always endeavors to protect the referring dentist's interests. In spite of this consideration, many patients have been lost to dentists through loss of confidence. Unfortunately, we also find that some practitioners, after failing in an operation, try to protect themselves by subterfuge and give far-fetched reasons for then referring the case. This is not fair to the consultant or the patient.

DIAGNOSIS

In this day and time, we are well equipped to make accurate diagnoses. Our older practitioners may question whether we obtain better results than those operators of a former day. If we do not, it is because of failure to grasp our opportunities and not through lack of facilities. Combining the evidence produced by clinical examination, roentgenographic findings, laboratory and microscopic aids, together with case histories, which may be obtained from the family physician, we should not often err in our decisions regarding the saving or elimination of teeth. Since my remarks are to be devoted to the condemned tooth or teeth, I shall briefly analyze diagnostic aids in relation to exodontia procedure.

The roentgen rays are not an infallible guide, but if pictures are properly angulated and processed, they are capable of furnishing accurate information quite proportionately to the operator's ability to interpret them. Poorly produced roentgenograms can be, and often are, misleading, and no reliance should be placed on them. All too frequently, those taken by the medical fraternity fall into this class. Many dentists as well seem careless in this regard and are satisfied with mediocre pictures. With opportunities at our hand for obtaining correct reproductions, it seems short-sighted to be satisfied with less than the best. In the larger centers, the commercial labor-

atories have entered the roentgenographic field and, perhaps because of low fees, are patronized by many physicians and dentists. Standards are bound to be lowered by such procedure, for these agencies are selling pictures. The patient is entitled to a professional interpretation.

If the dentist will correctly roentgenograph every tooth that he is to remove, he will go far in eliminating uncertainty. Your reaction may be that such precautions are unnecessary in many instances. True enough; but unlooked for abnormalities in root formations, unsuspected infectious processes in apical areas, unforeseen involvements of antrums, nerve trunks or foramina and various other complicating conditions occur frequently, and it is a fair assumption that the dentist who has a complete preoperative visualization of his case will cause far less trauma than he who operates blindly. An immediate postoperative roentgenographic check-up is also informative. The presence of broken pieces of filling materials or spiculae of bone in the socket, undetected rough osseous margins and fractured root tips, is, in the clinical care of the cavity, a common cause of postoperative discomfort and complications. I bespeak a more nearly universal employment of the roentgen rays for exodontia operations and urge a more painstaking attention to correctly made roentgenograms as well as a deeper study of the diagnostic values therein made possible.

The preliminary roentgenographic routine must, of course, be supplemented by a careful clinical examination, which should include not only the area of operation but also the mouth as a whole. The presence of active pathologic manifestations should greatly influence the operator in his care of the case. As a general rule, surgery should be avoided if active, acute reactions show themselves. If preliminary local medication or treatment can bring the tissues back nearly to the normal, it is a wise procedure to follow. Of course, this does not apply to acute abscesses which are pointing, when either lancing or extraction or both are indicated for immediate drainage.

Vincent's infection is becoming more and more a common complication. If unrecognized, it leads to postoperative trouble. It is advisable to postpone surgical interference in its presence. An ideal routine would be approached by a prophylaxis just prior to all extraction. While regeneration often occurs promptly in the most unsanitary mouths, certainly a more favorable locale is offered by as clean a field as possible.

The general condition of the patient should also be considered in the preliminary plan of campaign. While complete physical examinations are not in the province of the dentist and are not often essential, a general understanding of the patient's mental make up and the presence of constitutional diseases should be contributing factors in outlining procedure. A casual conversation with the patient and keen powers of observation often bring to light important data. One of the chief benefits of such precaution is its bearing on the choice of anesthetic and the technic of administering it. Nervous and wrought up patients are usually more amenable if a narcosis is advised. If they prefer local anesthesia, or if it is advocated by the dentist, their mental state indicates the advisability of premedication for the purpose of obviating psychic shock and reducing the high tension which they are undergoing. Paleness of the lips and skin, combined with puffiness under the eyes, should suggest anemia. These signs tell us that liberal oxygenation must be used if nitrous oxide is the agent selected. The

hard and engorged vessels of the arteriosclerotic and the noisy wheezing of the asthmatic are guideposts for the alert operator. Many points could be cited to illustrate the ease with which much valuable diagnostic information may be obtained without unnecessarily alarming the patient. It is quite usual for the cardiac, the syphilitic, the hemophilic, the tuberculous and the diabetic to disclose voluntarily something of their histories.

ANESTHESIA

For momentary operations, such as the incising of acute abscesses, an ethyl cloride spray applied locally is frequently utilized when a narcosis is not desirable. In such instances, local anesthesia by injection fails to meet requirements. Many operators utilize ethyl cloride by inhalation for children when removing deciduous teeth. Excellent results are nearly uniformly obtained, but it must, of course, be remembered that primary anesthesia only is produced, and if work of any duration is contemplated, this anesthesia should rarely be selected.

Aside from individual preferences in selected cases, our most generally accepted office anesthetics are nitrous oxide and oxygen and procaine. A great many substitutes for cocaine have been developed, but procaine seems to best fulfil the requirements of a local agent. Ether and ethylene, primarily hospital anesthetics, are used in some offices. I cannot find in our literature nor can I see from experience that they offer any advantages over nitrous oxide and oxygen, and they assuredly present many outstanding disadvantages. The decision as to the type of anesthetic to be selected should be based, first, on the requirements brought out in the preliminary examination and, secondly, on the ability of the operator to administer the agent and carry the case to a successful termination. Too often, the general dentist reverses this order and, because of lack of experience in general anesthesia, is prone to operate exclusively under procaine, when better judgment would indicate a narcosis. This is not meant as an indictment of local anesthesia, for often it should be the agent of choice. It has contraindications, and, if it is utilized in the face of these, disaster is invited. Should such untoward symptoms be present that local anesthetics do not offer the greatest advantage, he does well, if not experienced or competent in nitrous oxide and oxygen administration, to refer the patient to more experienced hands.

Generally speaking, nitrous oxide and oxygen is the safest of all our anesthetics. Risks attached to its administration are not those inherent in the agent but due to the operator's lack of ability in handling it. Fortunately, its use in general practice is on the gain, for it presents no contraindictions except those presented by the dentist's limitation in experience.

The physical preparation of the patient for nitrous oxide and oxygen is simple and necessitates only emptying the stomach, lower bowel and bladder. Nausea is a rare occurrence if the narcosis is smooth and even. No physical preparation is needed if procaine is employed.

Premedication has its place in both anesthesias, and the barbiturates have largely supplanted the heavier opiates. With nitrous oxide and oxygen, the chief value lies in the sedative effect on the nervous system and the mental relaxation thereby attained. Overstimulated types demand proportionately heavier dosage to minimize the problem of resistance during the development of the anesthesia as well as helping toward a calm recovery. For normal types, we have found that refinements in technic

in administering the gases have decidedly lessened the necessity for premedication.

Premedication has long been utilized in conjunction with local anesthesia to subdue fear, excitement and nervousness. It seems now to be definitely proved that barbituric acid derivatives, such as luminal, sodium amytal or nembutal, reduce toxic effects if given one or two hours prior to the administration of the local anesthetic. It must be admitted that procaine has toxic possibilities. Fortunately, serious manifestations are rare in dental cases. Premedication, use of a sharp needle, slow injection without undue forcing of the solution and absolute sterility minimize these reactions.

If tissues are inflamed, the absorption of the agent is more rapid owing to vasodilatation, and must be accounted as one of the chief factors in unfortunate results. Pressure, vasoconstriction and anoxemia work together to produce local anesthesia. As absorption transpires through the lymphatics and the venous circulation, slow injection is always indicated. It has been noted that patients with hyperthyroidism, tuberculosis or fever are markedly susceptible. In such cases, the rate of absorption is more rapid than normal. If injection is made directly into a blood vessel, collapse may ensue. In the rare cases of collapse or convulsions, intravenous injections of 10 or 15 grains of sodium luminal are considered to be of paramount value. For respiratory failure, caffeine given intravenously or oxygen under pressure through the gas machine should be relied on to carry the patient through the toxic period.

The anoxemic signs under nitrous oxide and oxygen are so pronounced and such ample warning signals are evident that the anesthetist can easily avoid the danger zone. It should be borne in mind that oxygen is the reliable resuscitating agent and it can be delivered under pressure. Carbon dioxide may be administered by rebreathing or from a separate tank through the machine to irritate the respiratory passages and stimulate depth of respiration, but it is oxygen that resuscitates, and if the patient is not breathing, carbon dioxide is useless. It also must be used in a physiologic percentage or it may in itself cause disaster.

Recovery of the patient from the effects of nitrous oxide and oxygen is rapid owing to the fact that the gas is noncumulative, does not decompose and is at once replaced by oxygen. If the patient is kept quiet in the chair for a few minutes after operation or until quite normal and is allowed to expectorate into a basin, without the necessity of leaning forward to a cuspidor, stabilization soon occurs and postoperative nausea is thereby minimized. A properly equipped room should be provided for the patient during his remaining period in the office. A gauze pad, placed over the operative areas, and upon which he bites, further prevents swallowing of blood and walls out saliva until a clot has developed. If excessive swelling or edema is anticipated, ice packs should be applied immediately. Too continuous cold unduly chills an area and stimulates postoperative pain. Instructions to the patient are that the packs be kept on intermittently for ten or fifteen minute intervals, as long as swelling persists. No rinsing of the area is allowed for several hours and a bland wash, such as a physiologic sodium chloride solution, is suggested for rinsing after meals. General sedatives for control of postoperative pain nearly always obviate local medication with its consequent clot destruction.

DRESSINGS, PACKS, WICKS AND DRAINS

The employment of the terms "dressings," "packs," "wicks" and "drains"

has been rather indiscriminate on the part of the profession at large. To the nonanalytic mind, they represent the same thing; which is not true, for the idea embodied in each implies the performance of a distinct function. Scrupulous care should be taken to so express ourselves that our meaning is not misunderstood. If the niceties in distinctions as to expression are not observed, the nomenclature suffers correspondingly.

It is an obvious fact that dressings, packs, wicks and drains should be utilized in exodontia as the requirements demand. Differences of opinion inevitably arise, not as regards this fact, but as regards the indications for these treatments and the methods of carrying them out. I shall merely express what these terms mean to me and my conception of the situations which indicate their employment.

The word "dressing" may be given a rather broad interpretation and is not necessarily specific, although a distinct meaning can be given by the employment of the proper adjective. The application of a bandage or a remedy, and also the thing applied, is a dressing. An antiseptic dressing is one utilizing gauze impregnated with an antiseptic solution. A cocoon dressing is a wound dressing consisting of a layer of gauze and collodion. A dry dressing is the application to a wound of dry gauze, absorbent cotton, etc. An occlusive dressing is one which completely closes a wound. A protective dressing shields a part from injury or septic infection. Then, too, if we employ a pack, a wick or a drain to help consummate resolution of tissue, we have dressed the area. Further, we dress a socket when we clean out débris and trim margins, septums and soft tissue, whether other adjuncts are employed or not. Thus, we see that this term may be used with far more freedom than other words which in themselves imply a specific function, and that its employment suggests the general attention to the toilet of an area. As to the application of dressings, it goes without saying that, for external wounds, protection must be afforded to prevent contamination and maintain sterility. This is essential whether or not drains or wicks are indicated.

For oral wounds, a routine procedure of dressing the areas is indicated at the time of operation. This means the customary measure of removing septic material and the smoothing of rough osseous margins, to allow them to become covered with well-nourished soft tissue. A healthy blood clot demands this care. The added introduction of wicks depends upon the necessity of the case.

The term "pack" is often misused. The word itself implies the application of a dressing under compression. Its chief uses in the mouth are to force soft tissue away from bone or a tooth, to immobilize an area or to prevent or control a hemorrhage. We have learned that compression offers the best control in the latter situation. Whether styptics or coagulants should also be utilized rests in the judgment of the operator. Here, then, is the distinction between (1) a pack and a medicated wick for control of pain and (2) a drain.

For the control of postoperative bleeding, a tooth socket should first be dressed by removing all old septic clot and any other irritant *in situ*. This is done by gentle irrigation and the judicious use of a suitable curet. With the bleeding vessel located, a proper sized strip of medicated gauze is gently but firmly pressed into the wound. This should be of sufficient length to fill the socket completely and, upon it, a gauze tampon should be placed, upon which the patient bites firmly. Gauze is preferable to cot-

ton as it exfoliates more easily. In forty-eight hours, it may be gently withdrawn without disturbing the granulations. The fibers of cotton have a tendency to adhere to and pull the tissues, which re-establishes bleeding. If necessary, a suture may be taken to hold the pack in position and press the buccal and lingual flaps against the gauze.

In contrast to a "drain," a term which is self-explanatory, wicks may serve various purposes. They may be employed merely to keep a socket open, to serve as a vent, to aid in sterilizing the area or to carry and hold medicaments for control of pain. They may also, of course, be used for drainage.

In the case of an impacted tooth with inflammatory soft tissue involving the coronal portion, the old custom was to incise the flap. This procedure may exaggerate the symptoms. We prefer to avoid any traumatization until acute manifestations are gone and routinely insert a wick gently into any available crevice and around the crown. This is done without creating any wound, the wick acting as a cushion between the tooth and its opponent and thus minimizing discomfort. This wick also serves as a medium for the methylene blue powder which we employ for sterilization. As these areas are ideal habitats for Vincent's organisms, in suspected cases arsphenamine may be indicated. The wicking should be frequently renewed, until a normal condition of the soft tissue is restored.

Other things being equal, we prefer to have a normal blood clot fill a socket. If suppuration is present, a light wick of iodoform or mercurochrome gauze, inserted without pressure, acts as a vent and drain, allowing granulation to develop from the apical region. Thus, the opening does not close prematurely and cause a pocket to develop.

Medicated wicks holding suitable antiseptic and analgesic agents, preferably in the form of paste, are now and then indicated to control stubborn postoperative neuralgia. In such cases, if a well organized healthy clot is present, we prefer to control pain by the use of general sedatives or by other therapy.

Drainage, when indicated, is accomplished by using tubing, rubber dam or gauze strips. The same principles are here involved as in any other form of surgery. Drainage should be maintained as long as suppuration is present. It should be renewed as often as necessary to promote sanitation. If left in place too long, the drain has a tendency to become sealed in and thereby becomes an irritant. It then serves as a pack or plug and thus defeats the purpose sought by its use. After its removal, if the wound is an external one, the unorganized opening should be kept clean by protective dressings.

This brief outline as to nomenclature and indications for the use of these various adjuncts is not intended to be comprehensive. It is meant rather to serve as a synopsis, pointing out in a sketchy way a few fundamentals.

GENERAL CONSIDERATIONS REGARDING TECHNIC

In carrying out any operation, minimization of undue trauma must be our aim, and while the exact technical procedure may vary greatly with the preferences of the individual, it is the end result that we are concerned with. There are certain basic factors that cannot be overlooked. As before emphasized, a definite preoperative outline must be fixed in the operator's mind. He should be able to visualize his finished work accurately before starting it. By so doing, it becomes evident that false moves are eliminated and unneces-

sary destruction of soft and osseus structures is avoided. Hit and miss operating is a time consumer and is an important cause of postoperative discomfort. If the work is performed under a local anesthetic, the patient is conscious and his mental reactions are not pleasing. The average patient is intelligent enough to recognize expertness or incompetency when he sees it. If a general anesthetic is utilized, naturally the patient is not cognizant of procedure, but postoperative results tell the story of trauma nevertheless.

It becomes evident that a complete understanding of the structures involved in a case is imperative. To recognize abnormalities, we must first know the normal. The proximity of tooth roots to the inferior dental canal, the various foramina or the maxillary sinuses, pathologic involvement of these areas, the physical condition of the tooth in question, the strength of its crown, the direction of its roots, their size, shape and multiplicity, all become a part of our study. The successful accomplishment of the operation is fully as much a preoperative as an operative problem.

Fundamentally, we should remember that the outer and inner plates of the jaws are composed of cortical bone, which is hard, dense and difficult to cut. The teeth themselves are incased between these plates in cancellous osseous structure, which is comparatively easy of dissection. If undue force must be used to dislodge a tooth, a preliminary dissection to relieve the resistance is always in order. Intelligent cutting of soft or bony structures is good surgical procedure; while torn or bruised tissues bear the trademarks of careless or inefficient methods. When feasible, then, the interference necessary for successful removal should be confined to the areas between the plates.

Often trauma of soft tissues may be avoided by the reflection of a buccal or labial flap. This must be accomplished without injuring the periosteum. At the conclusion of the operation, the flap is allowed to fall back to its original position. Osseous margins should never be left unprotected by healthy, well nourished soft tissue. Usually the clot formation and the pressure of lips and cheek combine to hold a flap in place. Sutures, introduced without tension, are indicated if the result cannot be accomplished otherwise.

Forceps should be so constructed that, when they are applied, the force is exerted along the long axis of the tooth and in conformance with the root formation. The position of the operator in carrying out the movements of the instrument is an important detail. Lateral strain invites root fracture. Should such an accident occur, the operator need not be disturbed; for with this changed situation, the case immediately becomes reclassified, and a well thought out ossisector and lever procedure is instituted. This contingency should be prepared for in advance. An approximal tooth should never be used as a fulcrum for a lever. The outer plate serves this purpose admirably if the dissection has been confined to the cancellous bone, which, generally speaking, is the only bone necessary of removal. Failures in such cases are usually due to lack of forethought, misapplication of force, an underestimation of resistance and inadequate technical skill.

ANTRAL COMPLICATIONS

Inadvertent forcing of a fractured root into an antrum is an occasional occurrence. This root must be removed. An immediate roentgen-ray examination to orient it should be made, much experimental instrumental manipulation being

thus avoided. In simple cases, if the apical opening is sufficiently large, the tip may be floated down to the orifice by gentle irrigation and be delicately disengaged. Often, it is found lodged remotely from the socket and impossible to remove except by an ample extension of the opening. As a general rule, we feel it wiser to raise a buccal flap and create access through a new opening high up on the buccal plate, adjacent to the position of the root, rather than destroy the roof of the tooth socket. Thus, better vision is obtained and direct access secured. A diagnostic lamp and a suction pump are extremely useful, the first in illuminating the antrum and the second in guiding the root to the orifice. This general procedure may be followed in dissecting an antral cyst or in the removal of polypi. With the flap replaced and sutured, the mouth is thus walled off and a closed wound made, unless drainage is indicated. A tooth socket, the apex of which has been enlarged, is apt to be sluggish in healing and contamination of the sinus from the mouth difficult to avoid. Suppurative antrums necessarily must be drained, and the nasal opening, if obstructed, should be enlarged. Strictly speaking, the maxillary sinus is in the field of the rhinologist. It becomes of oral interest, if linked up with a tooth to be extracted. The less the general dentist experiments with this sinus, the happier he is; and usually the patient is benefited as well.

So many little niceties in technic and so much of the personal equation enter into the handling of cases and patients that no individual could hope to lay down hard and fast rules governing conduct.

SUMMARY

Fear of pain has been a powerful retarding factor in the development of exodontia, and this fear has been to a great extent justified. An enlightened public presents itself today, relying on us to carry it through its exodontia problems, minimizing its worry and discomfort and with assurance of safety. The onus of responsibility is on our shoulders. As we fail to meet the issue, the whole practice of dentistry suffers. If we as individuals succeed, the status of the whole profession is correspondingly enhanced.

We, and our patients, will benefit if we standardize procedures along accepted lines. As a basis for standardization, we must recognize the importance of correct diagnoses and utilize to the fullest extent our facilities for obtaining them. We must be versed in the theory and practice of all anesthesia as it applies to our work. We must develop a technical ability that will enable us to operate in all cases without undue traumatization. Finally, we must not forget that we are largely responsible for our patients' mental as well as physical reactions from our operations. If we reverse the situation, and visualize ourselves in their position, our vision will tend to broaden.

270 Commonwealth Avenue.

THE BEHAVIOR OF SILICIOUS CEMENTS*

By K. W. Ray, Ph.D., Chicago, Ill.

IF plastic silicate cement fillings and restorations were entirely satisfactory from the standpoint of permanency and utilitarian value, they would be almost the ideal filling material. Clinical experience has shown that they are far from satisfactory when compared to the ideal. Silicious cements shrink while setting and are not entirely insoluble in the oral fluids, and their adaptability to the walls of cavities leaves much to be desired. Furthermore, in many cases, especially in the past, the use of silicate cements as fillings has caused the death of the pulp of the tooth.

Even though it has long been known that silicious cements have many objections as filling materials, their use has continued on a large scale. Many practitioners apparently get satisfactory results when using them; while others get poor results and condemn their use. Few unbiased scientific studies have been made to determine their actual value or the best technic for their use. Most of the manufacturers give directions for the use of their product, but, in many cases, these directions are based upon the results of tests on a few properties, such as translucency and rate of set, without consideration of the many other important properties.

Several studies of silicious cements were made in Germany soon after their appearance, but since the products of today are quite different from the original ones, the results of these early studies are not of great value in determining the properties and the value of the present-day products.

Little has been published concerning the composition and methods of making of silicious cements. Most manufacturers keep this information as a trade secret, and about the only information appearing in the literature is the results of a few chemical analysis and some patent specifications. Voelker[1] gives the composition of some of the older silicate cements, and Tompkins[2] mentions their probable average composition. He also mentions some of the methods of preparation used. (Table 1.) Some of the early cements, especially Ascher's new enamel and Ames' berylite, contained beryllium oxide in place of part or all of the aluminum oxide, but the superiority of beryllium oxide has never been proved. Some of the early cements were prepared by the chemical precipitation of aluminum silicate, which was then washed, dried and calcined at a red heat, but the modern products are probably prepared by the actual fusion of the constituents into a glass, which is subsequently ground and crushed to a very fine powder. The liquid used in all cases is probably a solution of orthophosphoric acid modified by

*Read at the Seventy-Fifth Annual Session of the American Dental Association in conjunction with the Chicago Centennial Dental Congress, Aug. 8, 1933.

1. Voelker, C. C.: D. Summary, 36: 177-200 (March) 1916.

2. Tompkins, H. E.: D. Items Int., 44: 881-887 (Dec.) 1922.

the addition of certain oxides, especially those of aluminum and zinc. I have been unable to obtain the exact composition and methods of preparation of any of the silicious cements as made at the present time.

Only a little more is known concerning the physical and physiologic properties of the silicate cements than is known about their composition. One of the most serious early defects of these filling materials was their property of devitalizing the tooth. Tompkins[2] observed that the alpha cements, that is, those whose liquid is composed of free phosphoric acid diluted with water, are much more dangerous to the pulps of teeth than the sigma cements, which are those whose liquid is death. He showed that copper cements are fully as acid as the silicate cements, but there is no evidence of pulp death in teeth containing copper cement filling. He concludes that the death of the pulp is due either to infection (both zinc and copper phosphates are known to be germicidal, while silicates are not) or to the pressure of the filling. C. Pincus[5] ascribes the destructive action to the fluorides in the cement which are liberated as hydrofluoric acid during the setting of the cement. The hydrofluoric acid is then said to penetrate to the pulp, causing its death. Thus, while it appears that the exact cause of the pulp death is in doubt, the general opinion at the present time is that all danger of pulp death

TABLE 1.—COMPOSITION OF SILICIOUS CEMENTS

Constituent	Harvardid	Berylite	Synthetic Porcelain	Average Composition
Silica	40.26	44	36.91	40-44
Aluminum oxide	50.62	41	33.69	38-50
Calcium oxide	5.00	2	7.26	6-12
Potassium and sodium oxide	1.08	13	15.88	1-12
Other constituents: Water, phosphate and magnesia.				

a partly or completely neutralized solution of phosphoric acid. Doubleday[3] also studied the causes of the degeneration and death of the pulp in teeth containing silicious cement fillings. He concludes that the action is due to the presence of orthophosphoric acid and to the acid reaction of the acid aluminum phosphate that is formed. He also states that the colloidal silicic acid may have a poisonous action on the surrounding soft tissues. Crowell[4] presents striking evidence that it is not the acid reaction of the silicate cements that causes the pulp can be eliminated by the use of a thick varnish lining in deep cavities before the introduction of silicate cement fillings.

The fact that silicate cements are not germicidal has been quite generally accepted. Fraser[6] found also that silicious cements were impermeable by bacteria, but that some were permeable by water. In this work, he closed the tops of ampules containing sterile nutrient broth by filling the openings with the cements to be tested. The ampules were then placed in seeded broth and left for more than fifty days. At the end of this period, the broth in the ampules closed with the silicious cements was still sterile. When

3. Doubleday, F. N.: Brit. D. J., 47: 493-497 (May 1) 1926.

4. Crowell, W. S.: Physical Chemistry of Dental Cements, J.A.D.A., 14:1030 (June) 1927.

5. Pincus, C.: D. Sc. J. Australia, 4:18, 1929.

6. Fraser, C. Jane: J. D. Res., 9:507-517 (Aug.) 1929.

the ampules were then left in water for 150 days, the broth in many of the ampules was contaminated, which indicates that some water had passed either through or around the cements, and had carried some of the bacteria with it.

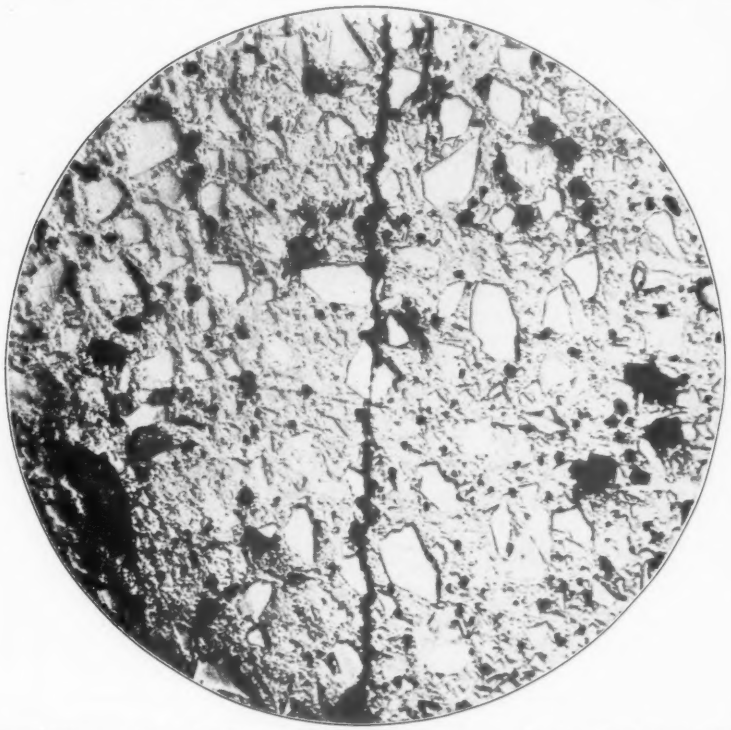

Fig. 1.—Microstructure of fully set silicious cement. The scratch through the center is the cut made by the microcharacter in determining the hardness of the sample. (×150.)

The general physical properties of silicate cements have not been studied as much as their importance warrants. Voelker[7] studied the hardness, solubility and a few other properties, but his methods were, in some cases, somewhat crude. His observations and conclusions are important. He found that the hardness of the various silicate cements varied greatly, and that Ames' berylite was very hard; Ascher's enamel and harvardid was medium in hardness, and synthetic porcelain was somewhat softer. He also found that the degree of solubility of the cements varied considerably and that the solubility of all of them was much greater in 1 per cent solutions of lactic acid than in distilled water. The solubility of the cements in water were in the following order (most soluble to least soluble) new harvardid, Ames' berylite, DeTray's synthetic porcelain

7. Voelker, C. C.: D. Cosmos, 58:1098-1110 (Oct.) 1916.

and Ascher's new enamel. Voelker also observed that all of the cements had a tendency to contract on setting, and that some of them showed bubbles and cracks when moistened with a dye solution when they had set under pressure. When the same cements had set without pressure, dye was absorbed more easily than before, but the cements showed no cracks or bubbles. He further observed that silicate cement fillings coming in contact with saliva a few minutes after the initial set had taken place compared very favorably, after a period of considerable time, with those made under the most exacting observation.

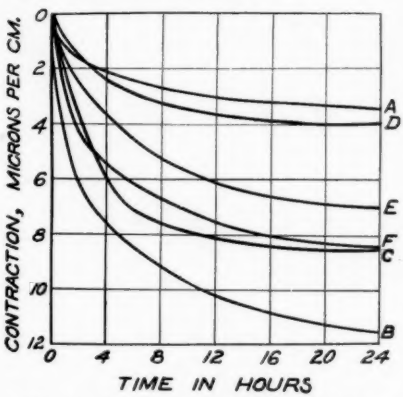

Fig. 2.—Contraction of six different silicious cements during setting.

Poetschke[8] made a rather thorough and careful study of the silicate cements. He used a well standardized technic and his results appear to have a high degree of precision. He studied the influence of several variables in mixing and also the crushing strength, setting time, temperature rise during setting and germicidal power of most of the common cements. Some of his results and conclusions are as follows: 1. The crushing strength of most cements increases rapidly during the first hour after mixing, reaching 60 per cent of the ultimate in some cases. There is a slow increase after this, extending over a considerable period. Some cements show a retrogression in strength after about twenty-eight days or less. 2. The rate of set increases with the increase in packing temperature. 3. The amount of powder required in mixing a cement increases with a decrease in mixing temperature. 4. The greater the amount of powder incorporated in the liquid, the stronger the cement will be. He found the ultimate crushing strengths

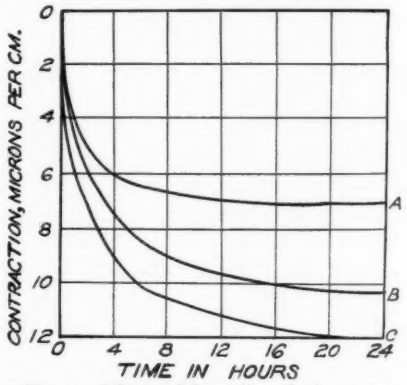

Fig. 3.—Effects of humidity of air on setting changes of cements. Curve *A*, cement mixed when the dew point was 40 F. Curve *B*, cement mixed when dew point was 60 F. Curve *C*, cement mixed when dew point was 70 F.

of some silicate cements to be as high as 1,448 pounds for a cylinder of cement 5 mm. in length and 5 mm. in diameter This corresponds to a strength of about 42,500 pounds per square inch. He did not study volume changes during the hardening of the cements.

Souder and Peters[9] made a few tests

8. Poetschke, Paul: J. of Ind. & Eng. Chem., 8:303 (April) 1916.

9. Souder, Wilmer, and Peters, C. G.: Tech. Paper Bur. Stand. No. 157, 1920.

on the dimensional changes during the setting of some of the silicious cements (synthetic porcelain) during their investigation of the physical properties of dental materials. They found that when the cements were allowed to set in air, they contracted very greatly, i. e., from 60 to 80 microns per centimeter during the first two hours. When the cements were allowed to set under water, the amount of contraction was very much less, amounting to only about 2 to 4 microns per centimeter during the first twenty hours. They also found the coefficient of linear expansion of the set cements to be about 7.8×10^{-6} per degree centigrade, which is about the same as the thermal expansion of a tooth. The names of the cements that were used, as well as the mixing procedures, were not disclosed.

This survey of the literature indicates the need for further study of the physical properties of silicious cements. The subject of the volume changes of cements during setting has been given practically no consideration even though this is one of the most important considerations in determining their value as a filling material. Furthermore, little recent work has been done on any of the modern silicate cements to determine the effects of variations in the technic used, and to determine which technic gives a filling with the best physical properties. It was the purpose of this investigation, therefore, (1) to make a study of some of the more important physical properties of the silicious cements and (2) to determine the effects of variations in the technic of mixing and packing in order to learn what technic gives the most satisfactory fillings. The cements used in this work were Ames' berylite, Ascher's artificial enamel, DeTray's synthetic porcelain, enamodent, Smith's certified enamel, and S. S. White's filling porcelain.

PHYSICAL PROPERTIES OF THE SILICIOUS CEMENTS

In mixing and packing the cements for the test specimens, the manufacturer's directions were followed as closely as possible. The cements were mixed with a stellite spatula, on the flat side of a bottle containing water at 65 F., in order to have a constant mixing temperature. The time of mixing was from one to two minutes and the cement was then packed into molds made of austenitic stainless steel that had been lightly oiled. The molds had a temperature of about 90 F. during the packing. After packing, the specimen was left in the mold about three minutes for the initial set to take place, and was then removed and coated with a varnish. It was then cut to exact length by a sharp steel knife. During this time of carving, requiring about two minutes, the sample was exposed to the temperature and to the dry air of the room, but little drying out occurred owing to the protection afforded by the varnish covering. After the specimen had been cut to the correct length, it was again coated lightly with a varnish and was then immersed in body-temperature water.

Even though the mixing and packing methods were as well standardized as was convenient, the results of tests did not agree so well as was desired. For this reason, the average of at least three results were taken for each test in most cases.

Since a large part of this paper deals with the changes of silicious cements during setting, a brief discussion of the mechanism of the setting of the silicious cements will be given.

The powder of a silicate cement consists of a very finely powdered silicate

glass or porcelain, the composition of which has already been discussed. This powdered silicate is of such a nature that it is easily decomposed by the modified phosphoric acid solution of which the liquid is composed. When the liquid and powder are mixed, the acid of the liquid attacks a part of the powder, forming colloidal aluminum phosphate and colloidal silicic acid. This reaction proceeds very slowly on a cold slab, but speeds up considerably when the mass is warmed. After a certain amount of the silicic acid has been formed and the acidity of the liquid has been decreased, the silicic acid gels, or partly sets. The reaction of the residual phosphoric acid and the incorporated powder continues for some time, the hardness and strength of the cement increasing accordingly. In no case does all of the liquid and powder react completely. During the reaction, the acidity of the liquid decreases and finally becomes so low that the reaction practically stops. This always occurs before all of the powder has been decomposed. Thus, the set cement is not a homogeneous product, but consists of some undecomposed silicate embedded in a matrix of the colloidal aluminum phosphate and silicic acid. (Fig. 1.) The translucency of the cement is primarily due to the fact that the silica gel and the unattacked power have about the same index of refraction of light, and the light penetrates the cement instead of being reflected by the particles. It appears that the reaction between the liquid and the powder, as well as the gelation or setting of the silicic acid, is accompanied by a slight contraction. The dehydration of the gel produces an enormous contraction, while its hydration produces expansion. It is the sum of these actions that determines whether the cement as a whole contracts or expands.

TABLE 2.—DIMENSIONAL CHANGES OCCURRING DURING THE SETTING OF SILICIOUS CEMENTS

Cement	CONTRACTION IN MICRONS PER CENTIMETER							
	First Trial		Second Trial		Third Trial		Average	
	6 hr.	24 hr.	6 hr.	24 hr.	6 hr.	24 hr.	6 hr.	24 hr.
A	2	3.0	2.5	3.5	3.0	4.0	2.5	3.5
B	10	12	8	11	8	12	8.5	11 5
C	6	8	8	10	5	8	6.0	8.5
D	2	3	4	5	3	4	3	4
E	4	7	5	7	5	9	4.5	7
F	6	8	8	8	7	10	7	8.5

DIMENSIONAL CHANGES DURING SETTING

The first tests were made to determine the amount of contraction or expansion during setting. The procedure adopted was the same as that specified by the A.D.A. research committee for determining the setting changes of amalgams, except that readings were taken after ten minutes from the time

of mixing. Also, the samples were held at body temperature submerged in distilled water during the tests. Some difficulty was encountered in adjusting the length of the samples since the velocity of light is less in water than in air, and consequently, a certain difference in length causes more interference lines when viewed under water than when the same difference is viewed in air. Also, this made changes in length of more than 10 microns difficult to determine accurately without readjusting the length of the sample. The greatest inaccuracy was undoubtedly due to the variations in the mixing technic and to other variables, and not in the measurements of the changes in length. The most important variable that was not controlled seemed to be the humidity. All of these first tests on the dimensional changes were made during the summer months when the absolute humidity was quite high. If the same tests had been conducted during the winter when the humidity is naturally much lower, the amount of contraction shown by the cements would probably have been much less. The results are shown in Table 2 and Figure 2. In these tests, it was found that all of the cements contracted some during setting, although the magnitude of the contraction was different for the different cements. As is shown later, these results cannot be taken to indicate which cement is best from the standpoint of dimensional changes, since the variations commonly met with in using these cements probably cause greater differences than the differences between the individual cements themselves. Since the results of the different tests did not check very closely, it seemed reasonable to assume that some important variable was not kept constant, and this was later found to be the humidity.

The dimensional changes during setting were also studied on a few of the cements by mixing them according to directions, but immersing them in water after their initial set, without covering them with any varnish. In all cases, the contraction was found to be less than when they were protected by varnish, and, in a few cases, a moderate degree of expansion occurred when the water was first added, but these samples soon began to contract. It was found that the longer the cements were exposed to the air, and the lower the humidity of the air, the greater was the amount of expansion. These tests indicated that the greater the amount of water lost by evaporation from a mixed cement, the more it will expand when it again becomes wet. When the cement samples were varnished, but left in dry air, the amount of contraction was enormous, sometimes amounting to as much as 150 microns in twenty-four hours.

The effect of many other variables on the dimensional changes during setting was studied, one of the most important of which appeared to be the relative humidity of the air at the temperature of the mixing slab during mixing. Any batch mixed just at the dew point contracted very greatly, while any batch mixed at a temperature of 20 F. or more above the dew point contracted much less. A series of tests were conducted by keeping the mixing temperature constant at 65 F. and by varying the absolute humidity or the dew point by boiling water within a small room. The results of these tests are shown in Figure 3. These results show that the closer the dew point is approached, the greater the contraction the cement undergoes during setting. This indicated that on warm, humid days, it might be better to mix the cement on a warm slab rather than on a cold one in order to have the

mix at a temperature far above the dew point. This idea was tried and found to be correct as far as contraction was concerned, although it affected some of the other properties unfavorably. The cements mixed on slabs as warm as 95 F. appeared to be satisfactory in many ways. They were found to contract very little, and in some cases actually to expand. The cements so mixed were always very slow to set and required an unusually thick coating of varnish to prevent weakness and cracking by an absorption of too much water before setting was completed. It appears that mixing on a warm slab would be necessary in certain warm, humid countries where the dew point is very high, as otherwise the moisture that collected on the mixing block would dilute the liquid too much for the best results.

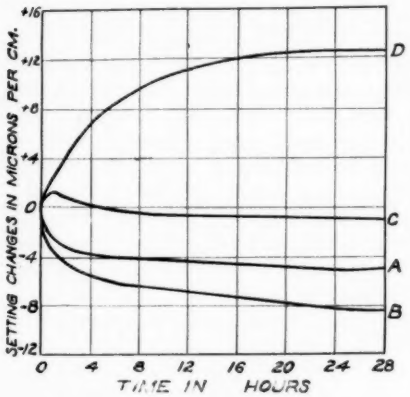

Fig. 4.—Effects of water content on setting changes of cement F. Curve *A*, cement mixed in usual manner. Curve *B*, cement mixed using liquid diluted with 5 per cent of its weight of water. Curve *C*, cement mixed on slab heated to 95 F. to cause evaporation of water during mixing process. Curve *D*, cement mixed using liquid from which 10 per cent of its weight of water had been evaporated.

The effects of the humidity on the setting changes of the cements appeared to be due to the change in the water content of the liquid during mixing. The vapor pressure of the liquid is such that water is lost when the relative humidity is very low and water is absorbed when the relative humidity is high. To test this, weighed portions of the liquid were exposed to air of varying degrees of humidity, and it was found that evaporation did occur in dry air and that absorption occurred when the relative humidity was high. As much as 5 per cent of the total liquid evaporated in five minutes when exposed at a temperature of 80 F. and a low humidity, and about 1 per cent increase in weight was found when it was exposed for five minutes at 5 degrees above the dew point, 65 F. This work indicates that the dimensional changes occurring during the setting of a silicious cement can be definitely controlled by controlling the composition of the liquid. The more water present, the

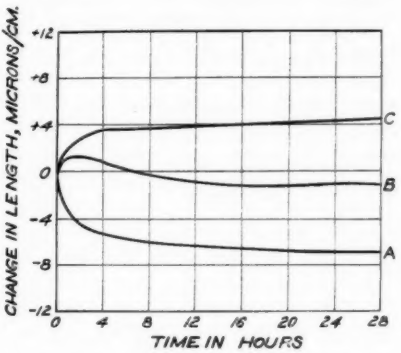

Fig. 5.—Effects of water content on setting changes of cement *E*. Curve *A*, cement mixed in usual way. Curve *B*, cement mixed on slab heated to 95 F. to cause evaporation of water during mixing process. Curve *C*, cement mixed using liquid from which 10 per cent of its weight of water had been evaporated.

faster the cement sets and the more it contracts; while the less the water content of the liquid, the slower it sets, and the more it expands. Figure 4 illustrates the dimensional changes occurring during the setting of cement F, and which can be produced by various means. Curve A shows the contraction of the cement when mixed in the ordinary way on a dry day. The contraction is about 5 microns per centimeter during the first twenty-eight hours. Curve B shows the contraction that occurs when the cement is mixed at 65 F. with the liquid diluted

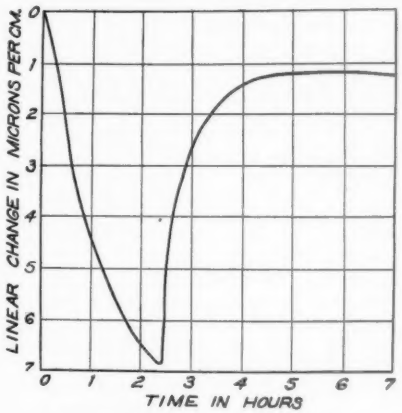

Fig. 6.—Changes occurring in fully set cement during exposure to air for two and one half hours followed by submergence in water.

about 5 per cent by being permitted to absorb water from saturated air. The contraction is about 8.5 microns per centimeter. Curve C shows the dimensional changes occurring when the cement is mixed at 90 F. with the dew point at 60 F. Sufficient drying occurs during the mixing to produce a slight expansion during the first hour after mixing. This is followed by a slight contraction, and after twenty-eight hours, the sample has contracted about 1 micron. Curve D shows the expansion occurring when the mixing technic is normal, except that the liquid has been concentrated by the evaporation of 10 per cent of its weight of water. The expansion is about 12.5 microns per centimeter. This specimen appeared normal in everyway at the end of twenty-eight hours, and had a high crushing strength. It was slow setting and required a heavy coating of varnish for protection from the water. The same effects are shown by most silicious cements. Figure 5 shows the setting changes produced in cement E, curve A being the setting changes in the cement as ordinarily mixed, curve B the changes when it is mixed on a warm slab in a dry room, and curve C the changes when the liquid has lost 10 per cent of its weight of water. These results show the importance of the temperature on mixing, as well as the water content of the liquid, on the volume changes occurring during the setting of silicious cements.

The thickness of the mix, that is, the amount of powder incorporated with the liquid, has little effect on the dimensional changes during setting. Certain mixes were made much thinner than the regular mixing consistency; others were made of average mixing consistency, while still others were made much thicker than average, and the contractions during setting of these mixes were nearly the same. The thicker mixes showed slightly less contraction than the thin mixes, but the differences were very nearly within the range of experimental error. The thickness of the mix has a marked effect on the hardness and the crushing strength of the set cements, as will be shown later.

One of the important limitations of silicious cements is the contraction which takes place when they are allowed to become dry. An old and fully set cement will contract enormously if left in dry air for some time. Figure 6 shows the dimensional changes that occurred in a

cement when it was exposed to air at a temperature of 85 F. and a relative humidity of 70 per cent for two and one-half hours and was then again submerged in water. It contracted quite rapidly during the time that it was allowed to dry out and expanded very rapidly when it again became wet. In this case, it never returned to its original size. Its appearance was entirely normal after this treatment, but the volume change was probably sufficient to destroy permanently the adaptation of an actual filling. Yet this treatment is probably no more severe than that which many fillings in anterior teeth are subjected to by even short periods of mouth breathing. This property of silicious cements makes them entirely unsatisfactory as a permanent filling material for mouth breathing patients. This property also makes it undesirable for any silicious cement filling to be permitted to become dry during any prolonged dental treatment. Covering the cement fillings with a varnish decreases the rate of contraction during such exposures, but does not prevent it entirely. In very warm, dry air, fillings covered with a light coating of varnish show as great a contraction as was shown in Figure 6.

WEIGHT AND VOLUME CHANGES DURING SETTING

In order to study both the weight changes and the volume changes of silicious cements during the setting period, samples were mixed and packed in the form of cylinders and their weight in air and in water was determined at certain intervals. The samples were weighed in air a few minutes after mixing, and were then immersed in body-temperature water, and the weight again determined. The weight in air was always taken rapidly, after the surface water was wiped off with a towel, and the cement was thus never allowed to dry out. The weight of the sample submerged in water was also taken with the usual precautions. From these weights, the size, specific gravity and the changes in weight and volume were calculated. In this way, it was learned that the cements contract in size and gain in weight simultaneously. Thus, their specific gravity increased

TABLE 3.—VOLUME AND WEIGHT CHANGES OF CEMENT F*

Date	Weight Dry Grains	Weight Under Water Grams	Size C.c.	Gain in Weight	Contraction C.c.	Specific Gravity
September 20	1.2742	0.6738	0.6004	.....	.....	2.10
September 21	1.2850	0.6880	0.5970	0.0108	0.0034	2.12
September 23	1.2925	0.6945	0.5980	0.0183	0.0024	2.16
September 26	1.2950	0.6988	0.5962	0.0208	0.0042	2.17
December 16	1.3000	0.7058	0.5942	0.0258	0.0062	2.18
March 15	1.3000	0.7062	0.5938	0.0258	0.0066	2.19

*Cement mixed and packed at 1 p.m., September 20.

quite appreciably. The experimental error in this work was quite large owing to the drying out of the specimen while it was being weighed in air and also due to the inaccuracies in the weight in water caused by the surface tension of the water. The general changes could be followed very readily and the results checked to a fair degree. Table 3 gives the results obtained when using cement F. In this cement, the contraction amounts to very nearly 1 per cent, the gain in weight to about 2 per cent and the change in the density to from 2.16 to 2.19.

Table 4 shows in summarized form the changes in weight, volume and specific gravity of the cements tested. While the large experimental error of this work makes it unsafe to place too much confidence in the individual results, the general trend can be noticed very easily. One other fact should be considered in relation to these changes, and that is that each sample was exposed to the air for a period of about one mintue after the surplus water was wiped from its surface, during the time it was weighed in air. This may have had a marked effect, although all of the samples had a normal appearance at the end of the six months. These results tend to indicate that water is absorbed and combined with the cement during setting, thus increasing the weight; and that the cement contracts slightly at the same time.

TABLE 4.—VOLUME AND WEIGHT CHANGES OF CEMENTS

Cement	After 1 Day		Specific Gravity	After 6 Days		Specific Gravity	After 6 Months		Specific Gravity
	Gain in Weight	Contraction		Gain in Weight	Contraction		Gain in Weight	Contraction	
A.....	0.0090	0.0010	2.20	0.0130	0.0020	2.22	0.0126	0.0086	2.22
D.....	0.0210	0.0010	2.14	0.0340	0.0002	2.16	0.0320	0.0017	2.17
F.....	0.0108	0.0034	2.12	0.0208	0.0042	2.17	0.0258	0.0066	2.19
E.....	0.0054	0.0138	2.18	0.0192	0.0050	2.17	0.0220	0.0048	2.18

HARDNESS OF SILICIOUS CEMENTS

The hardness of a silicious cement is an important property, but one which it is very difficult to measure accurately. All silicious cements are too brittle and possess too little flow to allow of hardness tests being made by the methods used in the determination of the hardness of metals. The microbrinell, the Vickers and the Rockwell were tried and all gave very erratic and untrustworthy results. Dr. Hodge and McKay[10] have shown that the microcharacter can be used to determine the hardness of teeth and tooth substance, and this led me to believe that the hardness of the cements could be determined in the same way. Therefore, four flat, specially prepared samples were mixed, covered with varnish and immersed in water, and then sent to Dr. Hodge for the hardness deter-

10. Hodge, H. C., and McKay, Harold: Microhardness of Teeth, J.A.D.A., 20:227-233 (Feb.) 1933.

mination. His results are shown in Table 5. Since silicious cements are not homogeneous, owing to the fact that they consist of a complex silicic acid gel as a matrix in which is scattered grains of the unaffected powder, the microhardness of the various constituents are different. Probably the hardness of the matrix cementing material is of most importance, and this can be increased by making thicker mixes as well as by many other methods. This preliminary work also indicates a great difference in the hardness of the material used as the powder. The cut made by the microcharacter is shown in the cement sample in Figure 1.

TABLE 5.—MICROHARDNESS OF SILICIOUS CEMENTS

Cement	Hardness of Matrix Average	Hardness of Grains of Unaffected Powder Average	Hardness of Whole Cement Average
B	182	1125	275
C	260	930	310
E	280	640	322
D (Thin mix)	106	1000	115
D (Thick mix)	230	1000	350

When the average hardness of the entire cement is noted, it is at once apparent that the cement is much softer than surface enamel (the softest surface enamel is about 1300 micro-units), but that the cement is actually much harder than the hardest gold inlays. The extreme brittleness of the cements cause them to be much weaker than many of the softer filling materials.

CRUSHING STRENGTH

The first crushing tests were made on samples 0.5 cm. in diameter and 2.0 cm. in length that had been prepared by packing the mixed cement in a cold, well oiled stainless steel mold. The samples were forced out of the mold into a bath of liquid cocoa butter before they had set, and were allowed to remain in the cocoa butter for five hours during setting. They were then transferred to a bath of body-temperature water, where they were stored for five days. In later tests, the specimens were formed by merely being rolled to approximately the correct size on the surface of an oiled glass slab with the palm of the hand. They were then placed in the cocoa butter as before. Duplicate tests indicated that the method of forming had no effect on the crushing strength of the specimen. Before crushing, the ends of all samples were ground plane and perpendicular on a slow moving emery wheel under water. Pieces of blotting paper were used at each end during the crushing test to take care of any surface irregularity and to distribute the stress evenly on the sample. Even though the samples were four times as long as their diameter, most of them split longitudinally during the crushing test. This behavior is probably due to their extreme brittleness and low tensile strength.

Crushing tests were made to determine the effects of (1) the temperature of mixing, (2) the mixing consistency and (3) the water content of the liquid used,

on the compressive strengths of the cements formed.

For determining the effects of the temperature of mixing, five specimens were prepared by mixing at a temperature of 60, five at 75, and five at 90 F. Each of these were treated and stored as already described. After five days, they were crushed and practically no difference in strength was detected between those made at 60 and those made at 75 F. All of these were slightly stronger than those made at 90 F. Even here, the difference was small, the specimens mixed at 90 F. having from 80 to 90 per cent of the strength of the others. The crushing strengths found varied from 5,650 to 8,450 pounds per square inch, values which are very low compared to the strengths of amalgams and porcelain.

The specimens for determining the effects of the thickness of the mix on the crushing strength were mixed at a temperature of 65 F. Five mixes that were definitely too thin because of a deficiency of powder, five mixes of the correct or average consistency and five mixes containing so much powder that the plasticity was greatly impaired were made. The differences in the crushing strengths of samples prepared from these mixes were much smaller than anticipated, although the strength of the correctly mixed specimens was somewhat greater than that of the others. The strength of the specimens prepared from the thin mixes was slightly greater than the strength of the specimens of the thickest mix. The difference was very nearly within the limits of experimental error.

Only two concentrations of the liquid were used in testing its effect. Five specimens were prepared, the liquid as received being used, and five were prepared by using a liquid from which 10 per cent of its weight of water had been evaporated. The results showed that the samples prepared by using the more concentrated liquid were fully as strong at the end of five days as those made from the liquid of usual concentration. Since the specimens prepared by using the concentrated liquid were slower to set than the others, the results would probably have been different if the samples had been crushed twenty-four hours after mixing instead of five days after.

RESULTS AND CONCLUSIONS

With a product in which so many properties must be satisfactory, as in silicious cements, it is very difficult to devise a method of improving any one or more properties without impairing some of the other properties of the material at the same time. This is why such products are improved so very slowly, and it is also the reason that a manufacturer is so loath to change his product in any way as long as there is a ready sale for it.

A silicious cement should have a convenient rate of set, a satisfactory color and translucency, a slight initial expansion followed by no change in size and a high crushing strength, and should not be soluble in the oral fluids and foods nor be injurious to the teeth or tooth tissues. The manufacturers have succeeded in getting a color, translucency, rate of set and a few other properties that are satisfactory, but have not yet been able to bring many of the other properties to the same state of satisfaction. I believe that the manufacturers, by a program of intense study, could greatly improve the general properties of silicious cements, but that this could be done only by testing all of the properties rather than the few that have been watched in the past. With the present cements, it appears impossible to devise a technic affording a filling that will expand during setting without at the same time changing the rate of set quite appreciably, and the

hardness and strength at least slightly. Since all of the properties cannot be satisfactory in the same mix, a compromise is necessary. By using the liquid and powder furnished by the manufacturers at the present time, and by mixing on a cold slab, a cement is obtained that has a convenient rate of set and that possesses the maximum hardness and strength, but it contracts from 2 to 10 parts per ten thousand. On the other hand, by mixing on a warm slab, a cement is obtained that is slow to set and possesses slightly less strength and hardness, but which contracts practically none, and, in some cases, expands during setting. If a mix is made by using a liquid with less water content, a cement is obtained that is slow to set, but which expands from 2 to 12 parts per ten thousand while setting, and which still has its full strength and hardness. Such a cement is more liable to become slightly discolored in the mouth since it absorbs more water from the oral fluids and foods than a cement made from the usual, more dilute liquid.

CONCLUSIONS

This work has demonstrated the following facts:

1. Most of the present-day silicious cements contract from 3 to 12 microns per centimeter during the first twenty-four hours when mixed and packed in the usual manner.

2. The amount of contraction a cement undergoes during setting depends primarily on its water content.

3. Water is lost by evaporation during the mixing of a cement when the relative humidity of the air at the temperature of the mixing slab is low, and the cement contracts less than it would if no water were lost.

4. Water is absorbed during the mixing of a cement when the mixing slab is held at a temperature near the dew point, and the cement contracts more than it would if no water were absorbed.

5. Silicious cements expand during setting if an extra concentrated liquid is used.

6. The more concentrated the liquid used, the slower a silicious cement sets, other conditions being equal.

7. The more diluted the liquid used, the more rapidly the cement sets.

8. Cements kept in water absorb water for long periods of time after setting, and may continue to contract at the same time.

9. Fully set silicious cements are much softer and weaker than the hardest tooth enamel.

10. Within certain limits, the more powder incorporated with the liquid during mixing, the harder the set cement will be. The crushing strength also increases slightly with an increase in the powder content.

11. The solubility of a fully set cement in distilled water appears to be so slight as to be of no consequence.

12. Cements contract rapidly when exposed to the air. When they again become wet, they expand rapidly, but do not quite regain their former size.

I shall not attempt to apply these facts by suggesting a technic for the use of silicious cements. The following five rules seem to be well indicated, even though they are not new:

1. Do not fill deep cavities in vital teeth with silicious cement fillings without using some precaution to guard against the devitalization of the pulp by the cement.

2. Do not mix a silicious cement on a slab cooled to within 5 to 10 degrees (F.) of the dew point. Use a warmer slab or wait for a dryer day.

3. Do not use silicious cements as a filling material in the teeth of mouth breathers.

4. Do not expose silicate cement fillings to the air during prolonged dental treatment. Keep them wet or covered with a very thick varnish covering.

5. Do not make the cement mix too thick or too thin. A mixed cement that is very plastic has the best physical properties.

CLEFT LIP AND PALATE SURGERY*

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PREOPERATIVE CARE

IT is axiomatic in cleft lip and palate surgery that an unimpaired physical condition of the patient is the primary safeguard against operative failure. Consequently, in our practice, no infant or child is operated on without being given a complete examination by a competent pediatrician, and without having a roentgenogram of the chest to determine whether the thymus is enlarged. A careful history is taken, and any recent exposure to contagious disease is considered as an indication for postponing operation until the incubation period for that disease has passed. If the examination reveals any physical disability which might tend to interfere with the child's ability to withstand whatever slight operative shock might be sustained, or tend to impair his healing powers, postponement is similarly indicated. Especially is the presence of an acute upper respiratory infection, no matter how mild, an indication for postponement, for healing of either lip or palate is greatly interfered with by the presence of infectious material in nasal or pharyngeal discharges. Before repair of the soft tissues of the palate, enlarged tonsils should be removed, and a period of six weeks should be allowed to elapse for complete healing of the tonsil fossae. If the thymus is enlarged, it should be reduced by roentgen-ray treatment before operation is attempted. Operation is never attempted until all such hazards, whether developmental, metabolic or infectious, have been eliminated.

OPERATION

The Brophy method, with only a few slight modifications, is used throughout. After an experience of fourteen years in the use of this method, during which time many of our late results have been studied, we are convinced that the Brophy principles are sound, particularly in regard to the restoration of the bony arch of the palate before repair of soft tissue defects is attempted.

Ether anesthesia is used entirely both in children and in adults. When it is administered by a skilled anesthetist, we have seen no ill effects due to prolonged ether anesthesia, even in infants a few weeks old. Infants and children up to 10 or 12 years of age are given a preliminary hypodermic injection of atropine for the purpose of drying up excessive bronchial secretion. The dose is graded according to age, and ranges

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from $\frac{1}{1000}$ grain up to 2 years of age, to $\frac{1}{150}$ grain after 12 years of age. After 12 years, morphine sulphate $\frac{1}{8}$ to $\frac{1}{4}$ grain is added for the usual sedative effect.

I believe that it is useless and unnecessary to attempt to sterilize the mucous membranes of the oral and nasal cavities in preparation for operation. Secretions or crusts are mechanically removed by cotton applicators or irrigation, and after the patient is anesthetized, a final cleansing is given with alcohol soaked gauze.

In describing the operative technic, I shall take for consideration the complete cleft of the lip, alveolar ridge and palate of an infant not over 5 months of age. (Fig. 1, left.) The cleft may be either on the right or on the left side, though, more often, it is on the left. Repair of this defect requires three operative stages.

The first operation is the closure of the alveolar ridge. In all these cases, the nose is angled to that side of the face opposite the cleft. The object of this first operation is to move the nose to its proper position and unite the alveolar ridge at the cleft to give a good foundation for the plastic operation on the lip and nostril and also to lessen the space between the margins of the cleft lip and the cleft in the hard palate.

The alveolar ridge is closed by placing 19 or 20 gage pure silver wire through the maxilla high above the alveolar ridge, above the tooth follicles, so that the development of the teeth will not be interfered with. Four wires are used. The wires are passed through lead plates on the buccal surface of the maxilla and the ends are twisted together over the plates. Thus, heavy pressure can be applied which will approximate the cleft in the region of the alveolar

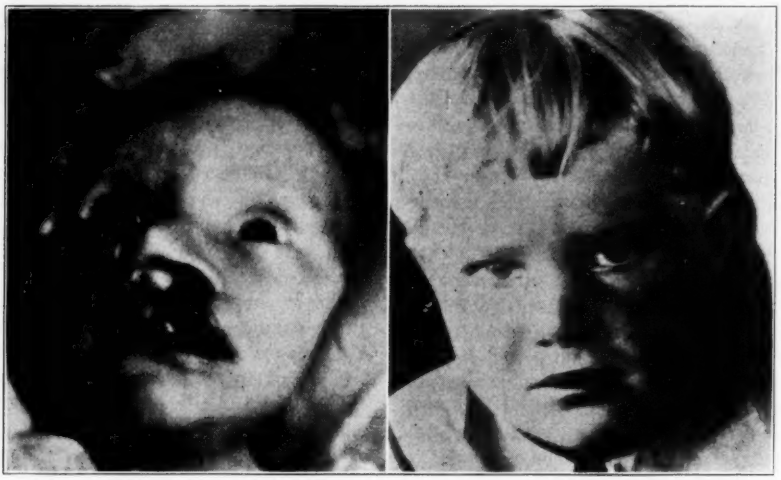

Fig. 1.—Left: Infant 2 months old with very wide unilateral cleft of lip, alveolar ridge and palate. Right: Child shown at left, at age of 3, complete closure of lip, alveolar ridge and palate having been accomplished by technic described.

ridge. At the point of contact, the parts are freshened that union may take place. These wires are left in place about six weeks.

I realize that the above described operation will bring out some adverse discussion, as some operators do not favor this operation, claiming that it interferes with the normal development of the teeth. After using this method for fourteen years, I am now seeing patients in whom the permanent teeth have erupted, and I am convinced that this wiring process does not interfere to any great extent with the development of the teeth. I would much prefer to have a normal straight nose in the median line of the face, with a good full lip, than to be assured that there would be no irregularity of the teeth. Modern dentistry can always take care of the teeth, if there is a normal alveolar ridge and palate.

I have had the opportunity to observe several cases wherein the lip was closed without previous closure of the alveolar ridge, and, in nearly every case, there was some deformity; i.e., flatness of the nostril, malalinement of the nose or a thinness of the lip, with little mucous surface showing.

Fig. 2.—Left: Adult case of complete cleft, of alveolar ridge, palate and lip. The alveolar ridge was closed by greenstick fracture as described. Right: Final result.

The second stage of the procedure is the plastic operation on the lip and nostril any time after 4 months of age. On the side of the cleft, the ala of the nostril and the cheek are dissected back over the malar process and well up toward the eye in order that the whole cheek can be moved over toward the nose, any strain on the tissues at the cleft thus being relieved when they are approximated. The ala of the nostril is first

approximated to conform as nearly as possible to the nostril on the opposite side. Flaps are then made in the tissue on either side of the cleft, starting from about one-third the distance above the skin-mucus line of the lip and ranging upward to the freshened margins at the nostril. Suturing is started at the nostril and worked downward, and as the skin-mucus line is approached, the excess of the flaps are pared away so that the skin-mucus line from one side will meet that of the opposite side, and the lip is rolled back and sutured on the mucous surface. Before the lip is closed in the nostril region, several sutures of catgut are placed in the underlying tissues, which help to bring the ala of the nose into what is nearly its normal position. After the suturing is complete, adhesive straps are placed on either check and united by the Logan bow, thus moving the cheeks over toward the median line. This relieves tension on the suture line and also results in a permanent slight shift of the soft tissues of the cheeks toward the median line; which aids in restoring normal symmetry to nostril and lip.

The third stage is the closure of the palate from 22 months to 2 years of age. With the Brophy periosteal elevators, starting at the margins of the cleft, all the soft tissue is freed from the hard palate on either side almost to the gingival margin of the teeth so that the mucoperiosteal flaps can be approximated in the median line. In cases wherein the margins of these flaps do not come together easily and there will thus be strain on the sutures that unite them, it is necessary to make a lateral incision on one or both sides close to the gingiva, leading around the tuberosity and out into the cheek. The margins of the posterior flaps are freshened to the tips of the uvula on either side. (In all congenital clefts, there is part of the uvula on either side.) Two secondary supporting silver suture wires of 22 gage are placed in the soft palate on either side and well back from the freshened margins. From the region of the uvula, and with the mattress stitch, the horsehair sutures are all placed before being tied off. At this time, the wires (the ends of which are passed through lead plates) are tightened, approximating the freshened margins of the cleft, and leaving no strain on the horsehair sutures, which hold the freshened margins in absolute contact.

If lateral incisions are made, they are packed with iodoform gauze saturated in compound tincture of benzoin, and the packs are left in for four or five days. The lateral incisions close by granulation. The palate suturing is all removed in ten days. (Fig. 1, right.)

The postoperative care consists of keeping the patient on liquid or very soft diet, washing out the mouth several times daily with boric solution, and applying one-fourth strength iodine once daily to the incisions. Four or 5 drops of 20 per cent argyrol is used in each nostril once daily. Restlessness is controlled with appropriate sedatives, i.e., phenobarbital, paregoric or codeine. Fluids are forced by mouth, by rectum and subcutaneously. In infants, the feeding established before operation is resumed as soon as reaction from the anesthetic occurs.

In cases of double cleft, when there is a protrusion of the premaxillary bone, a section is removed from the septum, posterior to the protruding part. This allows the anterior portion to be placed back in position to form the anterior part of the alveolar ridge. The same wiring method is used as in the single cleft, hard palate operation.

In adult cases of hard palate cleft,

when the bone has become solidified, it is necessary to make a greenstick break on the long side to approximate the parts of the alveolar ridge. (Fig. 2, left.) The Brophy-Shearer method is used, which consists of laying back a triangular flap over the bicuspids and cuspid. With a thin chisel, the bone between the cuspid and first bicuspid is separated, and the incision is carried up into the ala of the nose. With heavy pressure, the bone is broken over so that the points of the alveolar ridge are brought into contact. With a hand drill, holes are made in the bone on either side of the cleft, and 20 gage silver wire is passed through these holes and tightened. The points of the ridge are freshened at their contact so that they will unite, and the wire is left in about six weeks. (Fig. 2, right.)

The technic used in operating on a double cleft lip is almost similar to that used in operating on a single cleft lip. A muscular dissection is made on either side, freeing the ala and the adjoining tissue so that the ala on each side can be brought into proper apposition with no heavy straining of the tissue. There is generally a middle peduncle of lip tissue attached to the septum, the margin of which is pared away all around, and the nostrils are formed, and flaps made as in the single cleft operation. These flaps are turned down and built around the middle portion. The excess of the flaps is pared away at the median line so that the skin-mucus line from one side meets the skin-mucus line of the opposite side. Adhesive cheek straps are then placed and connected by the Logan bow as in the single cleft operation. Postoperative care is the same as is given in the single cleft cases.

PERIODONTOCLASIA: ETIOLOGY AND TREATMENT*

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IF anything were needed to justify a consideration of the cause and treatment of periodontoclasia, a subject about which much has already been said and written, it is to be found in the fact that it is one of the commonest diseases of adult life[1] and is still little understood by the rank and file of the profession. Indeed, it may be said that even among that small group who devote all their time to its study and treatment, there is diversity of opinion as to its causes and the means best adapted to its cure. And when it is further realized that all the factors in its etiology are at present not known, that it expresses itself in a variety of symptoms and that it may reach a stage in its progress so advanced that no treatment will avail, one is not surprised at the prevailing confusion nor at the unsatisfactory results often obtained in treatment.

*Read at the Seventy-Fifth Annual Session of the American Dental Association in conjunction with the Chicago Centennial Dental Congress, Aug. 8, 1933.

1. Hartzell, T. B.: Practical Things Every Dentist Should Know Regarding Treatment of Periodontoclasia, J.A.D.A., 16:1466 (Aug.) 1929.

It should be said by way of encouragement that our failure as a profession to deal successfully with this disease is not due so much to ignorance regarding its etiology and treatment as it is to neglect to apply in daily practice the knowledge already at hand, which, if properly brought to bear, would make the prevention and treatment of periodontoclasia one of the most satisfactory procedures of dental practice. It is with a view to clearing up some of these perplexities that this paper has been prepared, for it can be said without fear of contradiction that periodontoclasia is a preventable and curable disease needing only the application of present-day knowledge, incomplete though that is, to the problems of daily practice, to insure a large measure of success.

PATHOLOGY

Periodontoclasia is a disease the most prominent characteristic of which is the destruction of the alveolar process. If this phenomenon is carefully studied, it will be found that it always begins, clinically speaking, at the crest, and slowly advances toward the apices of the roots. It will be further observed that this destruction is not uniform around the roots of the teeth, nor does it uniformly involve all the teeth. Careful scrutiny will reveal the fact that, as a rule, it is in those regions of the mouth and those areas around the teeth that are least well cared for that bone loss is most liable to occur. It will be noted that it is between the teeth and in the molar regions that periodontoclasia is most prone to develop. This would seem to indicate that there is something in the local conditions that, to a considerable exent, controls pocket formation. If this were not so, and if a systemic condition were the dominant factor, one would expect to find uniformity of bone loss throughout the mouth and about the individual teeth; which is not the case.

Accompanying this destruction of the alveolar process and more or less coincident with it, there follows a long list of symptoms such as partial loss of the pericementum, pocket formation, infection, suppuration, tooth mobility and the like. If treatment is neglected, these will increase in severity until the entire alveolar process is destroyed and the teeth are lost. And what is equally important is its influence meanwhile on the health and well being of the patient; for it constitutes a chronic focus of infection which may lead to more or less serious systemic disability. No one can study the investigations of Cook,[2] Haden,[3] MacNevin-Vaughan[4] and others, without a new realization of the potential seriousness of periodontoclasia as a primary focus of infection.

ETIOLOGY

For convenience, the etiologic factors in periodontoclasia may be divided into three general groups: (1) a systemic metabolic disturbance, usually represented by an excess of basic elements in the body fluids; (2) a subnormal metabolism in the periodontal tissues by which their susceptibility to infection is increased, and (3) bacterial infection.

Of these, the first is the most complex and the one about which least is known. It may or may not be present in all cases, and if present, it may express itself with varying intensity. In one case, it may be the dominant factor; in another, play

2. Cook, T. J.: Periodontoclasia: Relation of Diseases of Periodontium to Systemic Disease, J.A.D.A., 17:880 (May) 1930.

3. Haden, R. L.: Dental Infection and Systemic Disease, Philadelphia: Lea and Febiger, 1928.

4. MacNevin, M. G., and Vaughan, H. S.: Mouth Infection and Relation to Systemic Diseases, Purcell Research Memorial, 1930.

an inconspicuous part or be absent altogether. It has been defined as "an imbalance in the tissue fluids resulting from varying intensities of those factors which regulate neutrality in the body."[5]

In a word, it may be said that anything which tends to increase the alkalinity of the blood or tissue fluids above a certain optimal value predisposes to periodontoclasia.

Among these are diet, mode of life, environment, climate, endocrines, mental state, activity and age.[5] Of these, probably the most important is diet, for it is said: "When mineral metabolism is upset by an insufficient or unbalanced supply of minerals in the food or by a deficiency of vitamins C and D, severe loss of calcium from the skeleton results. The alveolar process shares in this general decalcification and becomes atrophic."[6]

Experimentation on dogs has shown that, in all cases in which the alkalinity of the diet was sufficiently increased, retrograde changes took place in bones regardless of the calcium-phosphorus ratio. It also showed that of all the bones, the alveolar process was most sensitive to dietary faults.[7]

According to Broderick,[8] periodontoclasia is not a disease at all, but a symptom of a general constitutional disease due to disordered metabolism and bringing about a condition of alkalosis. It seems probable therefore that a potent predisposing factor in periodontoclasia is nutrition, apparently associated with avitaminosis and disturbance of the acid-base balance of the body. These are closely connected, as vitamins are intimately concerned in the metabolism of the inorganic salts, especially of calcium and phosphorus. Maintenance of the acid-base equilibrium of the blood depends largely on calcium metabolism.[6]

In the second group are to be found all those conditions that interfere with normal function of the teeth and jaws. These are lack of vigorous use in mastication, malocclusion, loss of teeth, food impaction, trauma, etc. They are important chiefly as they interfere with local metabolism and decrease the resistance of the periodontal tissues to infection. They are usually of secondary importance as all may be present without causing disease. It is never any one condition or group of conditions that is directly responsible for the development of periodontoclasia, but the combination of metabolic disturbance, lowered resistance and bacterial infection.

Thirdly, there can be no doubt whatever that bacteria play a conspicuous part in the etiology of periodontoclasia. They may be said to be the active factor in every typical case, all the others being largely predisposing in their nature. Any local condition about the teeth which facilitates the lodgement and growth of bacteria or which lowers tissue resistance may be regarded as a cause of periodontoclasia.

It is Simonton's[9] opinion that, in all cases, the essential etiologic factor is the lowering of the resistance of the soft

5. Jones, Martha R.: Larson, N. P. and Pritchard, G. P.: Acid-Base Balance of Blood in Relation to Dental Decay and Alveolar Atrophy, D. Cosmos., 72:797 (Aug.) 1930.

6. Smith, D. T.: Oral Spirochetes and Related Organisms in Fusospirochetal Disease, Baltimore: Williams & Wilkins, 1932, p. 66.

7. Jones, Martha, and Simonton, F. V.: Mineral Metabolism in Relation to Alveolar Atrophy in Dogs, J.A.D.A., 15:881 (May) 1928.

8. Broderick, F. W.: Effect of Endocrine Derangement on Teeth, D. Cosmos., 63:135 (Feb.) 1921.

9. Simonton, F. V.: Etiology of Parodontoclasia, J.A.D.A., 14:1767 (Oct.) 1927.

tissues, permitting the resident microorganisms to invade.

These organisms are principally the fusiform bacilli, vibrios, spirochetes and cocci acting in symbiosis.[6] All are in the nature of opportunists: none are specific. They are present in every mouth, their number depending on the oral hygiene. Even the fusospirochetal organisms which are thought of as being present only in cases of Vincent's infection are never absent from the mouth. Mead[10] reports having found them in 3,000 routine examinations of patients seen in daily practice.

Hartzell[11] gives first place to the cocci group, saying that "the streptococcus and staphylococcus are together the principal elements in the causation of that type of periodontoclasia in which we have pyorrhea." He says further, "I have conclusively shown that pyorrhea cannot exist without pyogenic bacteria; that individuals may be on the worst possible diet and, notwithstanding, if the necks of the teeth adjacent to the soft tissues are kept sufficiently free from bacteria, and the soft tissues are daily stimulated by friction and pressure, no periodontoclasia, or pyorrhea, can exist."

The latter observation is confirmed by Roy,[12] who says that "a pus pocket never forms at any point of the gums that is carefully brushed daily with a stiff brush." It is Smith's[13] opinion that the anaerobes are the chief causative organisms in periodontoclasia. He says:

> Once these anaerobic organisms have gained a foothold in a microscopic pocket, they multiply with great rapidity and produce powerful necrotizing enzymes which destroy the adjacent pericementum and still further enlarge the pocket. . . When we recall how these organisms acting in symbiosis can destroy the entire face in noma, ulcerate the tonsils in fusospirochetal angina, destroy the gums in necrotic gingivitis, destroy the elastic layer of the bronchus in bronchiectasis, and necrotize bone in tropical ulcer, it is not surprising that they can eventually destroy even the tough fibers of the pericementum.

It may be said in this connection that it is a matter of less importance than is the recognition of the influential rôle which bacteria play in etiology.

TREATMENT

Treatment of periodontoclasia should be directed toward the elimination of three factors: (1) the disordered metabolism; (2) bacterial infection, including treatment of pockets, and (3) lowered resistance of the periodontal tissues. No treatment is complete which does not take all three under consideration. The first may or may not be present; the other two always are.

Treatment of Metabolic Disorder.— The first requisite is a careful and painstaking examination including roentgenograms of all the teeth.

In those cases in which an individual pocket or two has developed and which can be explained by local conditions, there will probably be no need for systemic treatment. In those in which there is a more or less general breaking down of the alveolar process, especially in young adults, one should make careful inquiry regarding the patient's general health, habits of life, diet, etc. In some cases, it may be best to cooperate with the family physician in this aspect of treatment, as other diseases, such as diabetes, nephritis and duodenal ulcer, may be present. In all these cases, the diet

10. Mead, S. V.: Unpublished data.

11. Hartzell, T. B.: Important Factors in Etiology and Control of Periodontoclasia, J.A.D.A., 14:900-902 (May) 1927.

12. Roy, Maurice: Pyorrhea Alveolaris: Nature, Pathogeny and Treatment, D. Cosmos, 72:396 (April) 1930.

13. Footnote 6, p. 73.

should receive consideration as there is usually a deficiency of vitamins C and D. These are best supplied by three or four glasses of milk a day, from 8 to 15 ounces of orange or tomato juice, or both plus 1 or 2 teaspoonfuls of cod liver oil, three times daily. Milk will supply the needed calcium; the fruit juices, vitamins A, B and C, and the cod liver oil, vitamins A and D. The major part of the diet should be made up of vegetables and fruits. Bowel elimination should receive attention, and when not entirely normal, from 1 to 3 teaspoonfuls of psyllium seeds in a half glass of water should be taken each morning, the exact amount to be regulated according to need.

Elimination of the Bacterial Factor.—The correction of the bacterial factor through the elimination of pockets and the establishment of good hygiene is the *sine qua non* in treatment. Both of these measures are essential to complete success. How to accomplish this will depend on the depth of the pockets and the skill of the operator. The operation of choice is subgingival curettage, by which an instrument is passed to the bottom of the pocket and the root surface cleansed of its calculary deposits, bacterial accumulations, necrotic pericementum, etc. In properly chosen cases and when skilfully done, this leaves the mouth in a more nearly normal condition than is possible by any other method. The *modus operandi* by which this is accomplished has been frequently reported.[14]

In those cases wherein the pockets are deep, and especially in the molar regions where they are not so accessible, resort to surgical measures may be necessary. There are three types of operations that may be used in the advanced case: 1. The flap operation. Two vertical incisions are made at either end of the operative field, the septal gingivae are divided and the flap is laid back, after which the area is curetted, and the flap brought back into place and sutured. This is limited chiefly to the front of the mouth. 2. The division of each septal gingivae, retraction of the loosened gum tissue buccolingually, curettage of the exposed parts, the bringing of the two flaps back into position and suturing between each tooth. This operation, which is applicable to all the teeth, is being practiced with great skill by some operators. It permits of radical surgical measures with a minimum of disfigurement. 3. Resection of the gums to the level of the pockets and curettage of the roots and irregular bone line, after which there is packed around and between the teeth a medicated cement which is allowed to remain from two to four weeks; its purpose being to protect the teeth against thermal shock during convalescence and to prevent regeneration of the blood clot and possible reformation of the pocket. Generally speaking, this operation should be limited to the posterior teeth because of the inevitable gum recession and consequent disfigurement. All three operations have their place in the treatment of periodontoclasia, and they make possible the elimination of infection and the saving of teeth that would otherwise be lost. After completion of the operative procedures, the most careful attention to oral hygiene becomes necessary. This will include regular prophylactic treatments and the most painstaking and persevering care by the patient with a view to reducing the bacterial flora and the stimulation of periodontal circulation. To accomplish this, each patient should be taught correct principles of toothbrushing and the use of waxed silk tape,

14. Merritt, A. H.: Periodontal Diseases, Diagnosis and Treatment, New York: The Macmillan Company, 1930, p. 114.

toothpicks, etc. Toothbrushes of proper size and shape should be prescribed, as should dentifrices of known composition. From two to four brushings a day are necessary, a different brush being used each time.

Treatment of Lowered Resistance.—The logical treatment of lowered resistance in the tissues of the periodontium is through function. Nothing is more helpful than the vigorous use of both jaws and teeth in mastication. Habit and the use of soft foods has brought about a relative disuse of both. As a result the jaws are small, the teeth malposed and impacted, with an increased susceptibility to disease.

Patients should be urged to masticate their food more vigorously than they do. The result would be not only healthier organs of mastication but healthier bodies also.

This should be supplemented by artificial stimulation or as it has been called "physical culture for the gingivae."[15] Not only should the brush be used to clean the teeth, but, what is equally important, it should also be used to promote periodontal circulation through friction and massage of the gums. By the vibratory method of tooth brushing, the gingivae should receive more or less vigorous stimulation. But this is not enough. After the completion of the toothbrushing operation, the patient should be instructed to place the already softened brush on the gums, high above the teeth, and massage them buccally and lingually each time the teeth are brushed. As in brushing the teeth, the patient should be taught a correct technic. It is not enough to tell the patient how to brush the teeth and gums; he must be taught by demonstration in his own mouth before he can be expected to do his part. Any patient who will follow instruction can, by proper use of the teeth in mastication and regular massage of the gums in the daily care of the mouth, do much to overcome this handicap of lowered resistance in the periodontal tissues and to maintain a standard of oral hygiene that will make the prevention and treatment of periodontoclasia one of the most satisfactory features of dental practice.

15. Stillman, P. R.: Physical Culture for Gingivae, D. Cosmos, 66:104 (Oct.) 1924.

SUMMARY

1. Periodontoclasia is a disease the chief characteristic of which is destruction of the alveolar process.

2. It is a chronic localized infection which may seriously affect the general health.

3. Its etiology is considered under three heads: (1) systemic disturbance in metabolism; (2) lowered resistance, bringing about an increased susceptibility to infection in the periodontal tissues, and (3) bacteria.

4. Treatment consists in correcting (usually through diet) the existing disturbance in nutrition; the stimulation of periodontal circulation through function and artificial massage, and the treatment of the local conditions through instrumentation. The latter is accomplished by either subgingival curettage or by surgical measures.

Three different types of surgical procedures are outlined: flap operation, modified flap operation and gum resection.

5. The importance of regular and systematic care of the mouth in postoperative treatment cannot be overemphasized.

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APPLICATION OF BIOLOGIC PRINCIPLES TO ORTHODONTIA*

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BEFORE reviewing our progress during the last one hundred years, it will be necessary for us to examine briefly the field as it existed at the beginning of this epoch, in order that we may determine what was known at that time and thus may better evaluate our progress during the period in question.

Conditions then were not as they are now. As there were no dental societies and no journals, knowledge had to be disseminated by word of mouth. It is not to be wondered, therefore, that we find in the early writings a complete ignorance of what the authors' contemporaries were teaching. Let us briefly review the field as it existed in 1833.

In 1743, Bunion had first used the term "orthopedics" in connection with regulation of the teeth, and we shall find that the orthopedic point of view has probably been the most popular and powerful in influencing the thinking of the specialty.

In 1757, Bourdet advocated extraction of the first deciduous molar to allow the cuspid room for its positioning and the extraction of lower first molars in developing cases of protruding chins.

In 1771, Hunter published his "Natural History of the Human Teeth." His keen powers of observation and his ability to set down his thoughts in an understandable manner are a revelation to us even to this day. He was the first to describe accurately the growth of the jaws and, with the exception of certain minor points, his views have stood the test of time and have been repeatedly proved to be correct. He dwelt at length on ideal occlusion, basing his ideas on his studies of lower animals, and he warned his readers of the evils of extraction.

Duval, in 1802, noted the fact that it was not only necessary to arrange teeth evenly in each jaw, but that "those of the upper jaw have a special connection with those of the lower, the least deviation from which diminishes the beauty of appearance and so forth."

Fuller, in 1810, attributed the projection of the mandible to a habit which caused this bone to remain projected.

In 1819, we find articles by Delabarre, and these, like those of Hunter, form a milestone in our knowledge of etiology. He cries out against the prevalent ignorance of such things as the growth of the bones of the face and claims that the laws governing these phenomena are properly the patrimony of the physician. He goes farther and says that there should be a special class of physicians who would devote themselves to the practice of diseases of the

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mouth. Among the factors in malconfiguration of the denture, he enumerates: 1. A defect in the conformation of the jaw. 2. A simple want of their development owing to the frail health of the individual. 3. An excess in the dimensions of all the teeth though the jaws are in other respects well formed. 4. The rapid development of the dentition of one jaw and the delay in that of the other. 5. The too great size of the teeth of one jaw which do not harmonize with those that are opposite them. Speaking of extraction, he says, "It is much easier to extract teeth than to determine whether it is absolutely necessary. The extraction of a tooth requires nothing more on the part of the practitioner than a certain degree of facility in the use of instruments that are usually employed in this operation, while the knowledge necessary to appreciate the consequences can only be acquired by time and study." Speaking of early extraction of deciduous teeth to make room for the succeeding teeth, he says, "It appears to me that none of them have examined these various questions, for they then would have seen that their system is essentially vicious; they would have perceived that the more the temporary teeth are removed, the more the jaws contract instead of their being by this means necessarily assisted and as it were forced to increase."

In giving advice as to when to treat and when not to, he cites very accurately the diagnostic signs of proper development of the denture, calling attention to the physiologic loosening of the deciduous teeth, the change in the form of the arches, the separation of the incisors taking place harmoniously in both jaws, the appearance of the first permanent molars, etc. He then calls attention to an hereditary tendency for the jaws to assume particular forms and then gives a classification that comes very close to that later to be advanced by Angle. This he bases on three positions of the inferior maxillary bone relative to the superior: (1) the upper teeth passing in front of the lower; (2) the upper and lower meeting edge to edge, and (3) the upper passing behind.

In 1825, Joseph Sigmund described quite fully the etiology of voluntary cases of underhung jaw. He claims that it has its inception at about the time of the deciduous denture:

> In these cases at the first commencement it occurs that one or both of the first eye teeth in the under jaw grows somewhat longer than the rest and are pointed at the top so that in shutting the mouth, the under jaw is prevented from taking its proper direction. The child, not being aware of the pernicious consequences, stretches out the lower jaw, attempting in that manner to overcome the difficulty of the free action of the teeth and constantly is seen in the act of pushing the lower jaw outwards. This, unobserved or neglected at first, grows into a determined habit and a mischief at first easily controlled becomes the foundation of this defect, for the jaw gradually lengthens itself out from the articulation on each side to relieve itself from the bad position in which it was placed and thus the jaw becomes completely underhung.

Passing over a number of writers of this period who reiterate the views already quoted and who are about evenly divided on the question of extraction, we come, in 1829, to Maury, who, while he had some erroneous ideas as to tooth development, gives us this:

> When the alveolar arches are compressed on the sides the anterior part is carried forward. The predisposition is frequently accompanied with a deformity of the bones of the nose which are pinched together so as to resemble the beak of the parroquet. I have frequently observed whole families in which this appeared to be hereditary. Second, the palate may be malformed in a contrary manner and present an arch much

flattened and very spacious, but then the arrangement of the tooth will not suffer, for, instead of being crowded, they will be separated from each other. I will here again remark that almost all those that are afflicted with rickets have good palates, which proves that rickets does not prevent the development of the bones of the jaw nor of those that are found enclosed in them.

In 1831, the presence of supernumerary teeth was advanced as a cause of irregularity, and, in 1834, we find, from the pen of William Imire, the following:

Irregularity is due to the want of jaw bone. Thumb sucking, intemperance of various kinds combined with artificial modes of living introduced by civilization and sudden transitions from heat to cold to which the teeth are subject—all these have a tendency to prevent the development of the bones.

In 1836, J. Patterson Clark spoke of irregularity as being sometimes due to the natural effect of a jaw stunted in its growth and not infrequently the effect of habit "as when a person musingly uses his tongue in a particular way or twists his mouth, or grinds his teeth during sleep."

This brings us up to the opening of the century that we are to consider, and we have witnessed the beginning of several controversies that are to rage up to the present time.

In the decade which started our century, there occurred two events which were destined to have important results. The first of these, in 1834, was the founding of the first dental society, and the other, the founding of the *American Journal of Dental Science*, the first dental periodical, and one which exercised marked influence on the profession for over sixty years. Both of these things contributed to the same effect: namely, the interchange of ideas and the dissemination of a common knowledge in the dental field.

In order to avoid a recital of names and dates in chronologic order, I have sought to enumerate the various etiologic factors that have been advanced and the arguments that have been given both to support and to refute them.

In 1836, Blandin, in talking about the effect of the denture on the expression of the face from the developmental standpoint, says:

The action of the teeth upon the jaws is two-fold. Directly, they affect the dental arches; indirectly, the lower border of the inferior maxillary bone, the inferior dental canal, the angle of the jaw, the mental process, the mental foramen, the relations of condyle and coronoid process, the pterygoid process, the malar tuberosity and the suborbital foramen.

He makes some of the following points: that the maxilla consists of two parts, the alveolar process and its base, and that the dental portion is always in direct proportion to the teeth and undergoes modifications in early life which are repeated at an advanced age. He cogitates on whether or not the succedaneous teeth occupy more, less or the same space as their predecessors, and believes with Hunter that there is no change. He talks about changes in the facial angle under the influence of the teeth and draws attention to the fact that, since the constantly elongating superior dental arch is backed up by the pterygoid process, it follows that the face will be projected forward by growth "which gives a more oblique direction to the facial line of Camper." This takes place in proportion to the eruption of the teeth.

In 1839, Nasmyth claimed that projection of the upper jaw is often the result of a habit of sucking the tongue or finger in infancy, but that in both upper jaw and lower jaw, projecting may arise from an arrest of development in the jaw when expansion of the arch is deficient. He also cites the observation that the prominent mouth is

found in uncivilized races. This same year, Rodrigues stated that irregularities of the teeth were due more to deformities of habit than anything else, and that the action of the muscles, through their long incorrect use, would change the forms of the bones. We find many papers during this period devoted to "fruitless sucking."

In 1840, DeLoude advanced the theory that supernumerary teeth were an etiologic factor in malformed dentures and also large teeth in a small jaw. He adds that malformation may be due "to heredity, where the child inherits the jaw of one parent and the teeth of the other."

In 1844, the work of the great Lefoulan was translated into English and became available to the profession. He talks of supernumerary and congenitally absent teeth, of fusion, of dystrophy, of impaction and cysts. He states that the process of eruption and arrangement of teeth is more orderly in those reared in the country and the poorer city classes. "The habit of exposure to changes of weather and of exercise in air frequently renewed . . . imparts a remarkable strength to the constitution." He studies the extraction theory critically and speaks against premature removal for anything but elimination of mechanical interference. He goes on to trace accurately the changes that follow injudicious extraction for treatment. Speaking of bad habits, he mentions, in addition to those already considered by others, the effect of pronunciation of the lingual sounds "in which the tongue striking against the anterior superior teeth seems to push them forward." He continues: "This gives rise to the anterior obliquity of the upper arch. We may remark that this deformity is very frequent with the English, resulting from the pronunciation of lingual syllables." He comments on the force of occlusion and the part that inclined planes play in abnormal dentition, and finally says:

> It is therefore now a fact in science that the vault of the palate and, much less, the dental arch are not unchangeably fixed in their dimensions as has long been believed by certain dentists wiser in theory than in practice. This idea, or rather this serious error so deeply imbedded in all minds, was one of the greatest obstacles to the progress of orthopedic dentistry. Practitioners, formerly convinced that they had to act on an inextensible circle, found no better way to restore the symmetry of the teeth than to extract one or more of them, or to gain space for one by filing all which did not contribute a little to narrow yet more the alveolar arch and to destroy the relation of dimension between the upper and the lower jaw.

Just previous to Lefoulan's work, Desirabode, in 1843, published his "Complete Elements of the Science and Arts of the Dentist." He pleads for a more general understanding of the basic sciences on the part of the dentist and describes quite accurately the changes that take place in the jaws during growth. Speaking of the force necessary to cause irregularity, he says, "It must not be supposed that any great force is necessary for this purpose; it requires only a slight default of antagonism between two powers in the midst of which the teeth are placed, that is to say, between the lips in the front and the tongue behind." In the same year, Thomas Berdmore, dentist to the king, stated unequivocally that the teeth of adults will not yield to pressure. He adds, "If we may tell the truth such notions belong to fancy, not to practice and such promises are founded on ignorance or intended for deceit."

During the next fifteen years, we find several ideas advanced that are signifi-

cant in any consideration of etiology. Among these, we might mention Mitchell, 1848, who claimed that one cause of irregularity of the permanent teeth was a defect in the correspondence that ought to exist between the growth of the jaws and the increased volume of the second series of teeth.

In 1849, Joseph Engel called attention to the change in angle of the lower jaw between birth and adulthood. He claimed also that the teeth shifted, and were any of them missing, those adjoining moved forward not backward, owing to constant chewing and usage.

In 1852, J. L. Levison sounded a note that was to become very popular when he said:

> The jaws of civilized men are more contracted than those of semi-barbarous races and this is the result of the direct violation of the Creator's laws who wills that the brain and nervous system of the growing child should not be over-taxed, and that the dental process of attempting to build up the organic instrument and cultivate the mental faculties at the same time is a matter almost impossible to accomplish.

In 1855, the extraction controversy flares again. From the paper by James Taylor entitled, "Method of Directing Second Dentition," I quote the following:

> It should be borne in mind that a majority of teeth appear much out of place and as if they would be very irregular when they first make their appearance and yet as the jaws expand and the teeth protrude, they acquire room and take the right position. The solicitude of the parent and the apparent irregularity observable by dentists often urge something to be done when "let alone" is all that is necessary. There is no part of the dental practice requiring so profound a knowledge of the operation of the economy as that which results to the eruption of the permanent teeth; a mere superficial observer will be constantly led astray, inflicting at every step far more injury than benefit. That practice which merely takes cognizance of one or two palpable difficulties, having no reference to collateral effects which must flow from it, is not much, if any short of quackery.

In 1858, we find report of a case of paralysis of the facial nerve caused by an injury during forceps delivery, and another of a case of congenital hypertrophy of the tongue and a partial amputation of this organ. Among the symptoms noted are flaring of the teeth, protrusion of the tongue, mandibular warpage and open bite.

In 1859, we first find growth and advancement of the third molars given as a cause for irregularities in the front of the mouth. This year is of greater importance to us through the fact that Charles Darwin published his book, "The Origin of the Species," which, together with subsequent work, was to exercise such a profound influence on all biologic thinking. It should be pointed out that the evolutionary idea was not new, but it remained for Darwin to put it into logical and understandable form. As we have seen, heredity had long been a weighty consideration in orthodontic thinking, but Darwin's work opened up several new avenues of study that had been purely speculative. The species had been thought of as separate entities that had occurred spontaneously, and embryology had been studied for background and, in some cases, for congenital possibilities. From Darwin's time on, the subjects of comparative anatomy and embryology took on new significance. Since all organisms were shown to have arisen from a common form, and since function and environment appeared to be the determining factors in changes of form, it now became possible for men to work in the field of comparative anatomy in their search for correlation and relationships. Embryology suddenly became significant when it was realized that ontogeny, or the develop-

ment of the individual, repeated phylogeny, or the life of the race. At the same time, it should be pointed out that Darwin's work did nothing to strengthen either side of the great argument, slowly but surely raising its head, as to whether function or heredity determined the form of the jaws.

To return to our own field, we find Bridgman, in 1858, talking of what he terms "lateral pressure." This force he divides into three classes: (1) the eruptive force, exerted when a tooth is trying to erupt between two others; (2) the force of the labial and lingual musculature working on the arch, and (3) the pressure from the tongue within, which is too weak to cause expansion. He has many good points on musculature, and recognizes the cuspid area as the point of greatest muscular activity. He is one of the first to insist on the significance of the inclined plane. He says, "In regulating the mouths of children, it is of far more consequence to secure corrections in this respect than as to actual number remaining, provided the symmetry of the anterior portion of the denture be not interfered with."

In 1859, J. Foster Flag stated that the causes of irregularity were hereditary and mechanical, "the hereditary generally affecting the incisors, while the mechanical causes influenced the bicuspids, the cuspidati being about equally affected by both." MacQuillen, in discussing this paper, said:

> The disposition on the part of parents to indulge a preference for soft food, almost to the entire exclusion of everything that requires a decided effort in mastication, is also highly reprehensible. The force demanded and the shock attendant upon the mastication of hard food is of decided advantage in enlarging and expanding the maxilla.

It was during this period that Sir John Tomes published his "Dental Physiology and Surgery," a very important work from our standpoint. He cites as etiologic factors lack of a proper ratio in the growth of the lower and upper jaw, leading to the condition commonly denominated "underhung." He was a staunch believer in the theory that the causes of irregularity were of a mechanical nature. As an encouraging example of what might be done toward the correction of dental malformation, he cites the successes obtained by orthopedic surgeons in restoring crooked and deformed limbs to natural form whether the patient is middle aged or young, and gives examples of the teeth of one jaw shifting in response to pressure exerted by those of the opposite jaw. "It can scarcely happen that we have irregularity in the teeth of one jaw without a corresponding irregularity in the teeth of the other jaw; the one following as a consequence of the other."

1861 should be looked on as the beginning of the general consideration of mouth breathing in relation to malocclusion. I do not mean that the first reference to it in the literature appears in that year, but that prior to this time it had been listed as a corollary symptom. From this time forward, it was to become the identification term of a definite syndrome.

George Catline, a painter of Indians, in the employ of the federal government, was struck by the difference between the savage and the white man in the matter of respiration, both asleep and awake. He published a little pamphlet entitled, "The Breath of Life," which dealt with the evils of mouth breathing. This caught the eye of a dentist, who passed it on. We see it given reviews and abstracts in the dental literature of the day. Apparently, it started men to thinking on the subject.

The illustrations of this little book are pen and ink sketches with the characteristic physiognomy of the mouth breather against that of the normal; drawn in such contrast as to immediately focus the attention of the reader. The man's observation was uncannily accurate and his correlation of this habit with pulmonary disease, etc., seemed indisputable. From this time on, attention is paid to this factor, as we shall see.

Emerson Colon Angell (1860) was the first to call attention to the significance of the "six year" molars. He commented on the nature of their eruption and the necessity of retaining them and all other permanent teeth, in order to establish correct occlusion of the teeth. It was he who named these teeth the keystones of the arch. He called attention to the spacing of teeth following extraction, and advised maintaining spaces instead of allowing or expecting them to close

In 1864, George Murray Humphrey published the results of his research on the growth of the face. These are familiar to all. It should be noted, that they were neglected until recently, when Keith and Campion, Brash, Hellman, Krogman, Todd and others reinvestigated this field.

Cornelius Ackerson Marvin (1866) raises up his voice against extraction and proceeds thus: "Nature makes all parts to correspond and when she supplies a certain number of teeth in the mouth, it is fair to infer that the presence of all those teeth is necessary to regularity and perfection. If they are crowded it indicates that there is unnatural contraction." He advocates expansion beginning with the molars and says, "In doing this, constant regard should be had to the facial expression, that the incisors be not moved so far outward as to give a swollen appearance to the lip." This is the first reference to the "toothy" appearance of orthodontic cases.

In the same year, Sidney Longhurst called attention to the comparative frequency of absence of the upper lateral incisors and to the fact that this omission tended to run in families. He further noted the union of these teeth to others and the fact that their forms were more frequently disturbed than those of any other teeth. He goes on to cite the literature on the supernumerary teeth and points out the fact that, in a vast majority of such cases, the lateral incisors are again the greatest offenders.

It was about this time that James Edmund Garretson brought out his monumental work on oral surgery. In this book, we find much from the growth standpoint that is of interest to the orthodontist. He stresses the springiness of the alveolar process and considers all of the teeth as so many wedges placed therein. "In proportion to the number of the deciduous teeth removed prematurely will be the curtailment in the size of that arch at least of its alveolar face." Shortly after this, we find two ideas cropping up that we have seen before, both of which are destined to become controversies, and both of which have been satisfactorily answered only in the last ten years. The first of these (Wedl) pertains to the significance of the nonseparation of the temporary teeth leading to irregularity in the second set, the second (Hepburn) having to do with the contraction of the jaw following premature extraction of temporary teeth. Hepburn says, "I do not for a moment suppose that any positive contraction of the jaw or alveoli takes place." He advances again as the prime cause of irregularity artificial life and other factors attendant on civilization.

In 1872, J. Langdon Downs makes some statements that are to lead to a very interesting correspondence between him and one of orthodontia's great men, Kingsley. Downs, a British physician, apparently conducted a home for the feeble minded. The gist of his observations as stated by him are as follows: "The excessive vaulting of the palate is due to the arrest of the development of the sphenoid or defective growth of the vomer. They are developmental defects and are caused long before the time when nursing is practiced, unless that habit be an intrauterine one. A marked character of the teeth of idiots is their irregularity as to position." He goes so far as to say that various symptoms of the mouth are of positive diagnostic value, "and among these, we find, of the most significant value however, is the condition of the palate. I have made a very large number of careful measurements of the mouths of the congenitally feeble minded and of intelligent persons of the same age, with the result of indicating, with some few exceptions, a markedly diminished width between posterior bicuspids of the two sides."

In 1873, L. Fleschmall spoke on the diagnostic value of teething in rachitis. He claims that one-third of all children are affected by rickets and that by far the greater number of these are fed artificially. He gives an accurate description of how the dystrophies of the teeth come about and how the onset can be determined from the teeth.

We next come to the work of a man whose contributions to dentistry constitute a distinct landmark in the progress of our science, Charles Sissmore Tomes. He leaned strongly toward the orthopedic theory and indeed was the most radical of all proponents up until this time, as we may conclude from the following:

> Teeth, when they are erupted, do not come down and take their places in a bone already prepared for them; on the contrary, that which there is to start with is absorbed, and the bone in which they are ultimately implanted is built up around them, no matter what position they may assume subsequent to their eruption. And the inference to be drawn from these facts is tolerably obvious; namely, that premature extraction or the extraction of the temporary teeth is perfectly unable to be the cause of contraction of the jaws. For unless the bony bar which lies below our imaginary line be distorted, it matters very little indeed, what happens above it, so long as the permanent teeth meet no obstruction during their exit from their cysts.
>
> Along the outsides of the dental arch, the muscular structures of the lips and cheeks are perpetually exercising pressure perfectly symmetrically, and on the inside the tongue is with equal persistency doing the same thing. Now if we imagine a plastic material placed between the tongue and the lips, it can not fail to be molded into the form of a regular dental arch, and this is precisely what happens with the mobile, freshly erupted teeth. There is, I believe, no such thing as a natural tendency towards the assumption of a regular form in a dental arch; the physical forces at work, namely, the lips and tongue, are amply sufficient to account for all of the phenomena observed; and explanations based upon such a tendency fall, like references to "vital force" as an explanation of physiological phenomena, into the category of mere forms of words calculated to clothe our real ignorance. . . . Now, as everyone can easily verify upon himself, the effect of the mouth being held open is to increase the tension of the soft parts about its angles, and the result of the increased pressure is to bring about a bending inwards at the corresponding point; i.e., the bicuspid region; at the same time, the median portion of the arch escapes the controlling pressure which would have been exercised by closed lips, and the effect of this is traceable in the excessive prominence of the median pair of incisors, and also their oblique positions, which makes them correspond with the form assumed by the inner surface of the lips when the mouth is open. The association of this form of contracted jaw with congenital idiocy, as well as some other considerations, leads me to infer that

the contraction of the face of the jaw is due to causes in operation from a very early period; but the agency of the lips and tongue is that which determines the positions of the teeth themselves.

1874, Simeon H. Guilford again advanced the idea that modern living was at the root of malocclusion and the degeneracy of the teeth and alveolar process, and added diet to our picture. He goes so far as to say:

Were there a sufficient proportion of lime salts in the alveolus and tooth substance, placed there in the economy of nature by the eating of proper food, this same food giving health and tonicity to the blood, strength to the nervous system and density to the muscles and soft tissues, and did we at the same time give our teeth enough hard work to do, it is safe to say that in the second succeeding generation irregularity would be unknown and decay almost so.

George T. Barker, in the discussion of Guilford's paper, said that the human jaws were degenerating and that there was not now room for thirty-two teeth; hence, he advocated extraction, especially of the first permanent molar, at an early date.

We now come to consider the work of Norman W. Kingsley, who has been called "the father of orthodontia." Kingsley wrote a great many articles throughout his long and useful life, and while his greatest contribution probably lay in the mechanical field, his comments on etiologic factors reveal him to be a keen observer and careful thinker.

I shall quote parts of a paper given in 1875:

Many forms of irregularity are directly traceable to inheritance and are transmitted peculiarities. Probably a very large proportion of cases where the irregularity in a dental arch is confined to one or two teeth, the primary cause, so far as that individual is concerned, is an hereditary family peculiarity. . . . Symmetry and harmony do not imply uniformity and the dental arch may be developed up to the highest type of perfection, and yet there exist as great a variety of form as there would be in the faces of the aggregated beauties of the world. Races, nations and families are thus represented without deformity.

He was another who believed that the maxilla and mandible are separate and independent of the alveolar process. He then gives voice to a thought that we have seen expressed before:

One of the most alarming characteristics of the present age and the present civilization is found in the rapidity of its movements and the activity of its mind . . . altogether inexplicable by the too commonly asserted influencing power of climate, hygiene or diet.

My argument from this, now almost universally recognized condition, is this: During the formative and eruptive periods of the permanent teeth, they are under the influence of an independent and peculiar vital (nervous) force; this innervation pushes on their development regardless of the more tardy growth of the osseous system; being implanted in a crowded condition, in underdeveloped maxillae, they never have an opportunity to recover from it and emerge in the same disordered arrangement in which the crowns were formed.

Kingsley classified the causes of irregularities as developmental and accidental; the developmental, operating prior to the eruption of the teeth, the accidental subsequently.

There can be no question that the Creator intended there should be perfect harmony in the development of physical and nervous systems and where such harmony exists, we come nearest to the standard of a perfect organization. This harmony of organizaiton, or true balance of the two systems, demands that in the earlier years of life, the brain and the nervous system be held in abeyance to the physical.

The healthier mental organization is of slower growth. If, therefore, we find that a certain mode of life destroys this harmony, breaks up this balance, there will follow necessarily, deterioration and destruction of the race; this is based on well recognized physiological law; if the brain and the nervous system are in an undue state of activity, the drain upon the sources of nu-

trition will be at the expense of the physical system.

Kingsley reasoned from these conclusions that the more precocious the intellect, the greater were the chances for abnormality in form. Hence, those dull of intellect should show a minimum of abnormality, since, in these cases, the nervous system placed little strain on the physical. This, you will note, was in direct contradiction to the views of Downs, previously mentioned, and the interesting correspondence before referred to was started. Kingsley claims to have measured a number of mouths of idiots and feeble minded persons, and found normal widths and less than the average amount of malocclusion. At the first opportunity, he visited Downs and went over Downs' material, and he states that Downs had mistaken a narrow arch for one that was perfectly normal. Downs, it should be remembered, was a physician. Kingsley apparently stands alone against the observation of all other investigators in this particular phase. In one of his papers, he says, "A recent writer has claimed that there is an exact limit to the distance teeth can be moved in a given time without injurious action, and places it at $\frac{1}{240}$ to $\frac{1}{160}$ of an inch every twelve hours. It is hardly necessary to show the absurdity of placing physiological or pathological action under a mathematical law, no matter how broad." One is led to wonder what Kingsley might have said about some of the recent engineering in orthodontia. Kingsley was not a hard and fast believer in retention of all teeth during the early period of his life, but following his acqaintance with Angle, he became a staunch advocate of Angle's views.

No review of orthodontia would be complete without reference to the work of Emelie Magitot, who, in 1877, published his "Treatise upon Anomalies of the Dental System in Man and Animals," the most elaborate and scholarly essay on the subject that had thus far appeared. He was a great believer in the potency of embryologic factors in disease and irregularity. He was the first to comprehensively study the evolution of tooth form from the simple conoid to the multicusped form and he stated that, as the simple forms are forsaken, the teeth diminish in number and become more complex in pattern. He stated that what might be normal for one species became an abnormality for another and that these might appear in "throwbacks." He ranked heredity as the first and most important cause of irregularity, and believed that these transmissions exist in a sexual affinity which might continue through generations or, by relation with new sexual influences, disappear suddenly; and which, in time, would disappear anyway, in response to that natural law which tends to the correction of irregularities.

It was about this time that Alton Howard Thompson began to write for the dental periodicals, and his contributions form one of the most interesting and instructive chapters in dental history. Thompson was a student of comparative anatomy and it was largely due to his influence, Weinberger tells us, that this subject was included in the dental curriculum. I shall quote from only one of his papers, "Dynamics of Dental Occlusion and the Structural Expenditure of Their Maintenance":

> The force with which the lower mandible is occluded against the superior maxillaries is, in the average mammiferous animal, probably without parallel in any department of animal mechanics. . . . The limited amount of tissue of which the apparatus is constructed does not appear capable of the intense manifestation of force demonstrated.

Another indication of the force is the development of the bones and muscles that support the teeth. The growth of the maxillaries exhibits dependence of the occlusion of the teeth for perfect and symmetrical production. Negative evidence is again furnished by mal- and asymmetrical development, due to irregular eruption of the teeth, and the growth of bone prevented by the loss of the stimulus of occlusion. This force exercises a potent and wonderful influence in the acceleration in the growth of the bones and muscles and the symmetrical molding of the face in normal development.

The muscular system is dependent upon the irritation of use for perfect development and the rising teeth require employment to effect successful eruption.

With the presence of the teeth and their active use, the integrity of the jaws and muscles may be said to be maintained. As these are gradually lost, the alveolus rapidly, and the maxillaries and muscles slowly, atrophy and become reduced. . . . Asymmetry is frequently observable in persons who acquire the habit of asymmetrical mastication when the teeth are yet present, owing to disease of the latter or some other lesion, upon one side.

A significant statement of Gunning's (1881) reads as follows: "The fact that, when the teeth are lost, the jaws are still able to act in functions other than mastication is no justification of the misleading statement that the teeth and jaws are independent of each other."

Julius Parreidt was a strong believer in the developmental power of function. His claim was that children were indulged in their love for soft food; whereas, they should be forced to masticate completely such things as hard crusts of bread, and thoroughly and slowly.

In 1881, an interesting character published his first orthodontic paper. Eugene S. Talbot was one of the most prolific of all orthodontic writers, his articles appearing in practically all of the dental journals and many of those of medicine. His book, "Irregularities of the Teeth," went through six editions, and it is from the fifth that most of his views are taken.

Talbot, probably owing to both his education and his inclination, was drawn to the field of heredity and an overwhelming number of his papers are on this phase, in relation to teratology, the production of monsters. He explains himself very fully and is the first man to go any farther into the subject than merely to note family resemblances. Under his chapter on history, we find this: "Ere the publication of Kingsley's work, I became convinced of the importance of acquired constitutional as well as of factors of hereditary origin."

He believed that the dental arches and alveolar process were separate and distinct from the maxillae and shows many drawings of palates of different forms but exhibiting the same dental width. He was a great believer in constitutional factors such as the eruptive diseases of childhood and the influence that these had in arresting development of the bones of the face. Thus, he held that irregularities of the teeth were often due to two conditions; those of constitutional origin which develop with the osseous system, and those of local origin. His views are stated in the following quotations:

From these conflicting factors it results that direct heredity is rare and that acquired influences are apt to expend their force upon unstable structure most subject to the struggle for existence occurring within the organism. The skull, jaws and teeth are predisposed to this struggle and hence peculiarly liable to the ply of hereditary influences or acquired defects of an ancestor.

Heredity hence usually furnishes, in the case of the jaws and teeth, merely powder to be lighted up by factors locally applied during the periods of stress after birth. Without these locally applied excitants, the types usually ascribed to heredity by dentists will not occur. Environment furnishes the match but it makes a great difference whether, as Havelock Ellis says, "The match be thrown into a powder magazine or the sea."

Many of Talbot's views on heredity and evolution are interesting. He points out, for instance, the fact that the young ape is more like the human being than is the old ape, and that ideal human proportions are presented in an exaggerated form in the human infant. These are the large head and brain, the small face, the hairlessness and the delicate bony system. He points out that, having attained these ideal proportions shortly after birth, both man and ape fall away to a zoologic degeneracy and premature senility, the ape falling much more rapidly and farther. He points out the fact that at birth the brain is approximately one-fifth the weight of the body and that during the first six months of life, it doubles in weight. "The effects of stress during this period would, under the law of economy of growth, either be felt in diminution of the quality or quantity of the brain or in the preservation of these at the expense of more transitory structures. Here the teeth, alveolar process and jaws would be affected." This is merely a restatement of the ideas of Levison and Kingsley. Under "Development of the Jaws," he says, "The embryologic relationships of the mouth area and the hypophysis seem to explain why constitutional disorders and infectious diseases influence growth and development of the maxillae, especially the lower. The changes about the face so common a characteristic of acromegaly are extreme illustrations of this." He discusses at great length the reasons for the degeneracy of man's jaw and claims that the lack of use of the jaw as a weapon has exercised a marked influence in reducing the size of this part. He asserts that another condition conductive to arrested development is the lack of maxillary exercise.

In considering constitutional disorders, he talks of the influence on the offspring of diseases that affected the mother during pregnancy, and then of cases of illness of the growing body. Among other things he mentions the influence of the great ductless glands (thyroid, thymus, suprarenals, pituitary body, bone marrow, etc.) which secrete principles necessary to the equal balance of nutrition.

He modifies most of his hereditary views by some such statement as the following: "Constant use may increase the size of the jaws, as in acrobats, especially those who use the jaws in various feats, like 'The Man with the Iron Jaw.' Jaws of tobacco chewers, singers, public speakers and of the early races who lived upon corn, shell, roots and so forth, show that the jaws may be favored in size development by use." Getting down to familiar cases, he talks of Class III as being due to a lengthening of the rami or to an arrested development of the upper face. Class II cases he speaks of as due to shortening of the rami or excessive development of the maxillae.

Talbot's labors covered a wide field. He was an indefatigable worker, and everything he saw, he converted into use; but one cannot but feel that, in many cases, he filled in gaps with material that frequently lessened the force of his arguments.

The year 1887 finds us embarking on an era that was to continue until very recently. Isaac B. Davenport might almost be called "The Voice Crying in the Wilderness." His paper, "The Significance of the Natural Form and Arrangement of the Dental Arches of Man, with a Consideration of the Changes Which Occur as a Result of Their Artificial Derangement by Filing or by Extraction of Teeth," was a partial statement of the principles that were, through Angle, to dominate this specialty for forty years. Davenport insisted that normal occlu-

sion be the end sought in regulating teeth, asserting that only in this manner could permanent results be gained. "Nature has furnished man with two dental arches, so formed and so placed in relation to each other as to be supported at every point, while permitting all movements necessary for the perfect comminution of its food." He describes the anatomic features of the individual teeth, their relations to one another and the manner in which occlusion of the upper and lower serves the best purpose of speech and mastication. He then proceeds to show how any change of form in any of the teeth, or loss of one or more teeth, so disturbed the normal relationships as to greatly lessen their efficiency. By way of a warning, he says:

> While analogy teaches that nature's form and arrangement of the dental organs are those best fitted to preserve them, evolved as these organs were under the general law of adaptation according to the need, it is true that diseases have appeared which oftentimes have overcome nature's provisions; but as we have only just begun to learn the causes of diseases, we can hardly jump to the conclusion that man has so changed all of his conditions that nature is disposing of his dental organs, nor can we suppose that he would be better adapted to his present conditions by extraction of teeth. . . . This position is strengthened by practical experience and observation, which prove not only the wisdom shown in the form arrangement of the dental organs, but that this form is today the best form known in which to preserve the teeth and their usefulness.

Some of Davenport's ideas are well worth recording here. "When the teeth are regular and well articulated, they remain so because the forces and resistances are evenly balanced." "Finally, the articulation is the only permanent retainer to be relied on." "The teeth will move till they find the best contact that circumstances can offer and that movement often never ceases, because the force never finds equilibrium." "In the treatment of our patients, it is hoped that if we can not all see our way clear upon this matter, that we may at least see far enough not to make the articulation worse by our operations than they are when brought to us."

A paragraph in Barker's "Endocrinology and Metabolism" is so apropos to an introduction to the next man to be considered that I shall quote it. Barker says:

> Progress has been furthered, not alone by investigators that have made original observations and experiments and have recorded their results, but also by those physicians that from time to time have taken stock, as it were, of the knowledge existent, and presented it to the profession in organized form. The ability thus to organize knowledge so as to prepare it for general diffusion is second in value only to the ability to conduct fruitful research. That ability in its highest form presupposes a mind of great compass and comprehensiveness, the power to weld widely divergent materials into a homegeneous and symmetrical unity, the faculty of seeing into the heart of things through masses of accessory details, as well as deftness in the use of language, a feeling for accuracy and for fairness in the distribution of credit, a broad training not only in the clinical but also in the preclinical medical sciences, and, finally, a calmness and sagacity of judgment that will insure caution and temperance in the consideration of matters concerning which there is still clash of opinion. We owe to the writers of good text books and comprehensive monographs, therefore, a debt that is not always fully recognized, for such writers are the preparers of paths that often lead quickly to the discovery of new knowledge.

Edward H. Angle published his first text in 1887, and there followed six other editions, the seventh appearing in 1907.

It should be stated at the beginning that Angle was not what is popularly known as a research worker. He was one of those rare individuals, described by

Barker, who could see through things and feret out the fundamental principles that lay behind what he saw. With what would be considered today only the rudiments of a scientific education, he made himself probably the best informed man that has ever graced the profession. He was a deep student of all of the allied fields of orthodontia, and from each, he plucked the significant in his thinking on malocclusion. That his writings have never done him justice, anyone will testify who knew him intimately.

Angle's studies of the normal led him to the formulation of his classification and his paper on the maxillary first molar was a defense of that classification. These two things probably constitute his greatest direct contribution to the field of etiology and, as has been repeatedly said, they elevated orthodontia from chaos to the realm of a science. The correctness of his observations and reasoning have been repeatedly proved and their undisputed acceptance has led to a vast improvement in methods of treatment and in results.

I cannot but feel that the founding of the Angle school of Orthodontia in 1900 was of equal importance in advancing all phases of the science. Here, for the first time, orthodonic knowledge became available in a well organized, coherent manner and coupled with this was the advantage of the tremendous enthusiasm of a great teacher. Mark Hopkins once said that students were not vessels to be filled, but fires to be lighted, and there were few who studied under Angle who did not go away from him infected with some of his spirit. One has only to look at the names of those who have contributed to the science since 1900 to realize the power of Angle as a teacher.

When we come to study his views on etiology, we do not find them a series of isolated items. He was the leading exponent of the orthopedic school, believing that bone was the servant of function and that wherever function was interfered with, bone would react, a deformity resulting. From his studies of evolution, he believed that the dental apparatus was the most important and the most primitive part of the human face and that the face had been built in response to the demands of the function of this one part. The organs of sight and of respiration had marked secondary invasions of this region and had been added without any lessening of the efficiency of the denture. It was upon such a basis that he reared his theory of normal occlusion and he held unequivocally that everything in the face was subject to the laws of occlusion.

The third, fourth and fifth paragraphs of his chapter on etiology sum up completely his views on this phase:

> All parts of the anatomy are liable to abnormalities in development, as medical literature bears abundant witness, but that no one part is more frequently at variance with the normal in its development than the dental apparatus is evinced by the fact that malocclusion of the teeth in some form is almost the rule rather than the exception.
>
> We are able to better understand the reason of this when we remember that the dental apparatus is not an organ with but a single function, like the eye or the ear, but that it is a very complex structure, with many functions, into which enter not only the jaws, dental arches, and teeth, but the muscles of mastication, the lips, tongue, nasal passages, palate, and throat, and that in addition to the function of mastication these are also concerned in the vital function of respiration, and also in speaking, singing, whistling, laughing, crying—in short, in the expression of all the various emotions. The different parts and combinations of parts entering into the performance of these various functions and acts are so intimately associated that even slight inharmony in the growth and development of any one may ultimately involve the whole apparatus, in-

terfering with the normal function of all, and even producing repulsive deformities, for the influence of these parts on each other is always continuous and progressive—toward the maintenance of harmony and the normal if normal, and toward the increase of inharmony and the abnormal if abnormal.

The causes of malocclusion, then, to be intelligently comprehended must be studied from the basis of the normal growth of the denture and its co-related parts. Most of the immediate causes are mechanical, yet whatever acts as a hindrance to Nature in performing her delicate offices in the unfolding of the various tissues composing the dental apparatus during its growth will be operative as a cause in producing malocclusion.

The present century is probably familiar to all of you. For over twenty years, the field was dominated by Angle and those whom he had taught. The writings of some of these men as they appeared in *The American Orthodontist* show the Angle influence, and they also show the studious nature of these pioneers. There is probably no finer collection of orthodontic papers in existence than those contained in the pages of this magazine that ran the course of its existence from 1907 to 1911. Here, we find the early works on orthodontia of Noyes, Hellman, Weinberger, Dewey, Grunberg, Oppenheim and others.

This era witnessed the elevation of a branch of general dentistry to a distinct and powerful specialty; but it also witnessed an exhibition of the inevitable human weakness to cheapen and to spoil that which has been found good. All sorts of men were given all sorts of short courses, and this vast influx of men, most of whom were attracted by the thoughts of monetary reward, has diluted the efforts of the few workers that the field has had during this period. Untrained in reasoning, and indeed in any field save that of mechanics, this group has had little or no interest in the scientific side of the field wherein the problems of etiology lie hidden. Ignorant of what fundamental knowledge was available, they have bowed down to every false god that was introduced, and later used it as an excuse for failure.

Owing to the insistence of Angle, premature extraction of the deciduous teeth and the extraction of permanent teeth for treatment purposes were for twenty years a dead issue, but of recent years extraction has reared its ugly head again until it is accepted in some countries and taught in some schools in this country as a necessary adjunct to correction.

I do not wish to leave the thought that nothing of a worth while nature has been done during these years. It would be unfair to pass unnoticed the work of Samuel J. Lewis, who has given us something definite and tangible on the extraction of deciduous teeth. Another field that promises something for the future and in which much impetus has been gained during the present century is that pertaining to gnathostatics and biometrics. While Simon was not the first to investigate this field, and while his conclusions have been found erroneous by most of the other workers, in it, he deserves credit for focusing the attention of the profession on it, and the various groups that are now engaged in formulating pictures of normal growth are probably doing the most signal service that orthodontia has ever received.

We have also witnessed a growth of interest in such things as endocrinology, diet and metabolism and arrested development, but all of these fields have been found so vast by the research workers in them and the profession has been so poorly equipped to evaluate them that application of what findings there are has been made in the most superficial manner and to date they are of little or no practical use to the clinician. It need

not be pointed out that the old questions as to whether the alveolar process is a part of or separate from their jaw bases, and as to the rôle of constitutional factors, mouthbreathing, habits, heredity, form and function, etc., are still with us and in much the same form in which they existed fifty years ago.

I should say that the blame for present day conditions in orthodontia are to be laid at the doors of those men who have given lip service only to the fundamentals, while teaching that orthodontia was a mechanical art. I hope and expect to see in the future a recognition of the principle of adequate university training in the fundamental sciences under competent teachers. If orthodontia is to progress in its more important phases, it will need broad-minded, scientifically trained men, capable of prosecuting research and properly evaluating that of others; and, after reviewing the literature, I would say: Men who read and think more, and talk less.

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FOREIGN BODIES OF DENTAL ORIGIN IN THE AIR PASSAGES AND LUNGS: A REVIEW OF THE LITERATURE, WITH HISTORY OF TEN CASES

By THOMAS C. BONNEY, D.D.S., Aberdeen, S. D.

IT is difficult to understand why there has not been more information available in the literature of dentistry in regard to aspiration accidents, particularly those occurring in dental offices. Considering the serious complications that may follow the aspiration of a foreign body into the lungs; considering also the responsibility that rests on the individual in whose practice such an accident may occur, it appears that the subject is one with which the profession should be thoroughly familiar. A careful review of the dental journals published during the past twenty years reveals a surprising paucity of articles on the subject, while several of the most important textbooks on anesthesia do not mention dental aspiration accidents. By far the larger number of these accidents are reported in medical literature, in connection with reports of series of cases of lung abscess. Even here, the rule is to mention them casually as one of the etiologic factors in suppurative disease of the lung, and in all too many cases, their importance is obscured by a mass of data relating to other etiologic factors which the writers apparently deem to be of much greater importance.

Dental aspiration accidents may be divided into two types: those in which a foreign body, such as a tooth, a part of a tooth or a gold crown, has been inhaled into the lung during the course of some dental operation, and those in which only blood or mucus has been inhaled. Either type of accident may cause serious, if not dangerous, complications, recovery from which may eventually take place only after a more or less protracted convalescence. Lung abscess with its always serious, if not extremely grave, sequelae may complicate

the picture, and even death may occur as a result. These complications are, of course, more liable to develop if the foreign body is not expelled or removed within a very short time after its entrance into the air passages or lungs. Fortunately, the aspiration of a foreign body into the air passages or lungs is an accident that occurs only rarely in each individual dentist's practice, an accident that is fraught with so much potential danger that it should ever be held in mind by one engaged in any operation within the oral cavity.

The teeth or their fragments are the foreign bodies most frequently associated with dental aspiration accidents, but the following additional objects have been found and reported by Jackson[1] and Gill[2]: dental burs, gold crowns, gold-porcelain bridges, small partial dentures or parts of them, fillings of various kinds, blades of forceps, hard rubber from a dental mouth prop, pieces of dental cement, tartar from teeth and root-canal reamers. Anyone who has seen one of these articles enter a patient's lung or who has watched a patient run the entire gamut of symptoms from the beginning cough to the development of pulmonary abscess, with all of the complications that usually go therewith, will agree that the profession can neither too often nor too forcibly be reminded of the ever-present possibility of such accidents and of the potential dangers that go hand-in-hand with them.

This communication has been prepared with the hope that it will direct the attention of the profession to the dangers associated with aspiration accidents, and that it will serve to impress on all operators the necessity for the greatest possible care when working in the mouth of a patient. The histories of a number of previously unreported cases are included in this report.

FREQUENCY OF OCCURRENCE

Jackson,[1] in an analysis of 1,728 cases involving the aspiration of foreign bodies, says that seventy-one (roughly about 4 per cent) were of dental origin, twenty-one, or about 33 per cent, of the foreign bodies being "teeth, whole or fragmentary, filled or unfilled." (The number of cases at Dr. Jackson's clinic is now, December, 1933, ninety-seven.) Gill,[2] in 1924, was able to find in the literature, foreign as well as domestic, a description of only 117 cases of aspiration accidents of dental origin. Like Jackson, Gill observed that teeth or fragments of them (about 89 per cent) were the foreign bodies most frequently aspirated. Keith[3] found but three foreign bodies of dental origin (8.5 per cent) in a series of thirty-five cases which came under his observation in the space of two and one-half years. Wessler[4] states that only two of 100 cases of suppuration and gangrene of the lung were caused by the aspiration of a foreign body. One of these cases (1 per cent) was of dental origin. Lockwood,[5] in a statistical review of lung abscess, reports fifty-four cases treated at the Mayo Clinic from April, 1920, to November, 1921. Of these cases, three (about 5 per cent) fol-

1. Jackson, Chevalier: Bronchoscopic Cases of Dental Interest: Dental Foreign Bodies in Air and Food Passages, J.A.D.A., 14:1341-1370 (Aug.) 1927.

2. Gill, E. G.: Foreign Bodies of Dental Origin in Lungs, J.A.M.A., 83:1738-1741 (Nov. 29) 1924.

3. Keith, A. B.: Borderline Cases in Dental and Oto-Rhino-Laryngological Practice, Am. D. Surgeon, 47:583 (Oct.) 1927.

4. Wessler, Harry: Suppuration and Gangrene of Lungs: A Study of 100 Cases J.A.M.A., 73: 1918-1921 (Dec. 27) 1919.

5. Lockwood, A. L.: Abscess of Lung, Surg. Gynec. Obst., 35:461-492 (Oct.) 1922.

lowed the extraction of teeth. Myerson,[6] in a personal communication, says:

> Of almost 300 lung abscesses which I have seen, only one (0.33 per cent) was due to the aspiration of an incisor tooth that slipped from the dental forcep during extraction. I have had three cases in which no abscess resulted but in which a crown, a tooth (bicuspid) and a denture consisting of a false tooth with a crown on either side dropped down a bronchus after they had slipped from the dentist's forceps or fingers.

Singer and Graham[7] report thirty-four cases of lung abscess and give "tooth extraction" as the cause of two of them (about 6 per cent). Dr. Singer writes:

> One of the cases of lung abscess followed the extraction of a tooth, and the other followed the actual aspiration of the tooth itself. The tooth was brought up by the patient several weeks later by an excessive attack of coughing. The other patient was operated on, with recovery.

In passing, it might be well to state that dental operations are not responsible for all cases of aspiration of teeth. As an example, Gilbert, in his discussion of a paper by Peters,[8] mentions a case in which a tooth was aspirated by a patient during the course of a tonsillectomy.[9] Dr. Gilbert writes:

> The boy had much coughing following the operation and at the end of eight or ten days was quite ill. The diagnosis was not made until two and one-half weeks after the operation and the tooth was removed by bronchoscopy a few days later. The temperature continued very high, and three weeks after the operation the temperature was 105 F., and there were marked symptoms of acute lung abscess. I then did an artificial pneumothorax, keeping the lung collapsed for about three and one-half months. The boy made a perfect recovery, and was still well at last report, three years after the operation.

Chevalier Jackson, in a personal communication, says he regards it as simply marvellous how rarely these accidents occur in view of the millions of times that dental work is done for the entire population. He is of the opinion that the frequency of dental aspiration accidents may be slightly greater than appears from available reports because of the fact that the presence of a foreign body, whether of dental or other origin, as a cause of pulmonary suppuration is often overlooked. It is quite likely also that a relatively large number of cases in which recovery results after early expulsion of the foreign body and in which there are no complications are not reported. This too would tend to make available statistics not entirely reliable.

Moore[10] found but five of 202 cases of lung abscess, (2.4 per cent), due to the presence of foreign bodies in the lung.

In spite of their relative infrequency, it must not be forgotten that dental aspiration accidents *do* occur, and that they will continue to occur in both general and special practice in spite of every safeguard that may be erected to prevent them. These accidents are potentially dangerous, and it is only by the constant exercise of care and vigilance that we can hope to prevent a definite increase in the frequency of their occurrence.

ETIOLOGIC FACTORS IN ASPIRATION ACCIDENTS

Aspiration either of a solid foreign body or of blood or mucus during the

6. Myerson, M. C.: Bronchoscopic Treatment of Lung Abscess, Surg. Gynec. Obst., 41:573-578 (Nov.) 1925.

7. Singer, J. J., and Graham, E. A.: Abscess of Lung, J.A.M.A., 81:193-196 (July 21) 1923.

8. Peters, U. J. W.: Abscess of Lung, J.A.M.A., 75:1060-1064 (Oct. 16) 1920.

9. Footnote 1, Figs. 18, 19, 25, 26, 27, 28, 32 and 33.

10. Moore, W. F.: Pulmonary Abscess: Analysis of 202 Cases Following Operative Work About Upper Air Passages, J.A.M.A., 78:1279-1281 (April 29) 1922.

course of any dental operation may result from: (1) the slipping from the fingers of any small instrument being used in the mouth; (2) the slipping from the fingers of any inlay, crown or small bridge while it is being fitted or placed in position in the mouth; (3) the slipping from the forceps of a tooth during the process of extraction; (4) failure to pack the mouth before any operation under a general anesthetic is begun; (5) a too profound anesthesia, whereby the throat reflexes are completely abolished; (6) changing the mouthpack while the patient is unconscious and while the mouth is full of blood and mucus in which may be particles of teeth, bone or fillings. (Changing the mouthpack may in some cases be imperative. Cessation of respiration, vomiting and excessive hemorrhage, principally, may necessitate such a procedure as is shown in Case 10.) Aspiration accidents occur in spite of every safeguard erected by the operator and despite every effort he may make to prevent them.

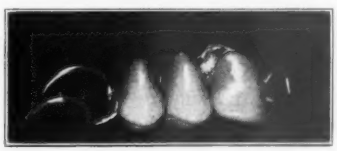

Fig. 1.—Buccal view of removable bridge described in case reported by Wilfred Wilson.

Clark[11] offers a valuable suggestion in regard to packing the mouth. He says: "Some years ago, I abandoned the use of gauze packs in favor of short-fiber hospital cotton mouthpacks, believing it is possible to pack the mouth more securely and that cotton is more likely to catch fragments than is gauze."

11. Clark, H. B.: Personal communication.

Featherstone[12] attempts to make a distinction between what he calls "continuous gas" and "single dose" anesthesia as etiologic factors in aspiration accidents. Little justification can be seen for this attempt.

Apparently, most aspiration accidents occur while the patient is under the influence of a general anesthetic. A number of cases have been reported by Jackson and Spencer[13] in which no anesthetic at all was used, and Jackson mentions deciduous teeth as having been aspirated independently of anesthesia or any dental procedure.[14] The fact that general anesthesia is an important, if not the most important, factor in aspiration accidents should be constantly kept in mind; and the possibility of these accidents should be looked on as one of the major hazards accompanying dental anesthesia practice.

Fig. 2.—Occlusal view of removable bridge shown in Figure 1.

SIZE OF ASPIRATED FOREIGN BODIES

The foreign bodies of dental origin that are aspirated usually are small.

12. Featherstone, H. W.: Quoted from Brit. D. J.: Bowen, C. F.: D. Summary, 42: 589-593 (July) 1922.

13. Jackson, Chevalier, and Spencer, W. H.: Gold Three-Tooth Bridge Removed from Right Bronchus, D. Summary, 28:142 (Feb.) 1918; Dental Broach in Bronchus: Report of Case, D. Cosmos, 61:201-203 (March) 1919.

14. Footnote 1, Figs. 36, 37, 38, 39, 40, 41, 42, 43, 44 and 45.

They include, as previously noted, fragments of teeth or bone, pieces of tartar, teeth, gold or porcelain crowns and small dental instruments. Some of the foreign bodies are relatively large. Among the larger ones are three-tooth bridges and parts of vulcanite dentures.

Vinson[15] reports a case where a patient aspirated into the right main bronchus a fragment of an upper denture. This fragment measured three quarters inch by one inch and carried three porcelain teeth. It seems almost impossible to believe that foreign bodies of such relatively enormous size could pass the vocal chords. Nevertheless they do, a great deal of trouble and anxiety ensuing. Vinson's patient was greatly exhausted from continual coughing and dyspnea. She was immediately relieved when the foreign body was removed bronchoscopically three days after its entrance into the lungs. Crich[16] reports a similar case. Wilson[17] reports a case in which the patient swallowed a three-tooth removable bridge carrying two clasps. (Figs. 1-2.) The bridge became lodged in the lower end of the descending colon. It was removed surgically but the patient died three days after the operation. This was not an aspiration accident, but a removable bridge could be aspirated with equally disastrous results.

POSSIBLE END-RESULTS OF ASPIRATION OF A FOREIGN BODY

Following the aspiration of a foreign body, one of several things may occur:

1. The foreign body may be coughed up (this occurs in about 3 per cent of cases) or it may have to be removed.

2. After early expulsion or removal of the foreign body, recovery may, and usually does, take place promptly and the patient remains entirely well.

3. Complete recovery with no complications may take place after expulsion or removal, even after a relatively long sojourn of the foreign body in the lungs.

4. A more or less lengthy convalescence, followed by a complete cure, may result after expulsion or removal of a foreign body from the lungs. This may occur even after a very short sojourn of the foreign body in the lungs.

5. Abscess formation may result regardless of the length of sojourn, and the abscess may or may not heal after expulsion or removal of the foreign body.

6. In cases of abscess formation followed by expulsion or removal of the foreign body, cure usually results. In some cases, if the abscess has ruptured into the pleural cavity, surgical intervention may be necessary before a cure can be effected.

7. In spite of everything that may be done, chronic lung abscess may develop as a result of which the patient may be doomed to a life of chronic invalidism.

8. Death may occur (*a*) from suffocation due to obstruction of the air passages, (*b*) from development of pulmonary suppuration with its subsequent complications or (*c*) as the result of any intercurrent infection or disease which under ordinary conditions of health might not be of serious import.

SYMPTOMS

In some cases symptoms may be entirely absent. While the history of an initial laryngeal spasm is of great importance in the diagnosis of a foreign body in the lower air passages, the lack of such a history by

15. Vinson, P. P.: Foreign Bodies of Unusual Interest Removed from Air Passages, Minnesota Med., 6:260-262 (April) 1923.

16. Crich, W. A.: Case Report of Foreign Body of Dental Origin in Bronchus, D. Cosmos, 74:240-242 (March) 1932.

17. Wilson, Wilfred: Removable Bridge Causes Death, Appolonian, 6:21 (Jan.) 1931.

no means excludes the possibility of a foreign body being present.[18]

In Gill's series of cases previously referred to, symptoms were entirely lacking in one case. Hedbloom[19] reports sixteen cases in which there were no symptoms of any kind; not even a cough.

In a personal communication, Chevalier Jackson says:

> This symptomless interval is the rule with non-obstructive metallic objects. Teeth, on the other hand, immediately, or very soon after, usually set up an irritating cough. And I might add that teeth set up suppuration more quickly even than bone.

Vinson[15] reports a case in which a gold crown was aspirated while the patient was having some dental work done. There were no symptoms at the time of the accident. The patient developed a "cold." The crown was discovered by roentgen-ray examination and was removed bronchoscopically ten years after the accident. Recovery with no complications followed the removal of the crown.

The principal symptoms and the usual order of their occurrence are cough, dyspnea, an asthma-like wheeze, pain and the expectoration of mucus in large quantities. In cases of relatively long standing, there is fever, the expectoration becomes foul and the patient loses weight.

In Case 1,[20] Case 3[21] and Case 4,[22] an unproductive cough was the only symptom present. Peters[23] records a case in which no symptoms developed until one full week after the accident. Jackson and Spencer[24] report a case in which no symptoms developed until the third day after the accident.

> In a typical case of foreign body inspirated at operation the patient gives no sign of ill-health for a number of weeks or sometimes for months afterwards, depending on the character of the foreign body and especially the degree of obstruction its shape may enable it to produce. A nonobstructive piece of steel instrument may cause no symptoms for many months. A tooth or piece of human bone on the other hand usually causes a slight cough within a few days (Jackson and Jackson).
>
> In concluding the matter of symptoms, it seems important to urge that more important than any symptoms is the knowledge, or even the slightest suspicion on the part of the dentist, that something has gone downward from the mouth.[1]

USE OF ROENTGEN RAYS

Manges[25] never makes a negative diagnosis of anything except metallic objects. Ginsburg[26] says that a negative roentgenogram is of doubtful value in the presence of diffuse pulmonary suppuration. If the size of the foreign body and the material of which it is composed, and the condition of the surrounding tissue, make it possible to visualize and so locate the foreign body, the roentgen rays are invaluable. They should always be used, therefore, as a routine part of every examination in cases of known or suspected foreign body aspiration.

DIAGNOSIS

In many cases, it is possible to make the diagnosis from the clinical history alone. The roentgen rays should always be used, and, in some cases, bronchoscopy is indicated as a diagnostic aid.

18. Footnote 1. Ballou, D. H.: Technic of Bronchoscopic Pneumography with Lipiodol, Surg. Gynec. Obst., 47:673 (Nov.) 1928.

19. Hedbloom, C. A.: Foreign Bodies of Dental Origin in Bronchus Pulmonary Complication, Ann. Surg., 71:568 (May) 1920.

20. H. L. E.: Verbal report.

21. Humphrey, R. I.: Verbal report.

22. Deeble, A. L.: Verbal report.

23. Peters, C. A.: Abstr. Canadian M.A.J., 14 (Oct.) 1924.

24. Footnote 13, second reference.

25. Manges, disc. of Jackson, Footnote 1.

26. Ginsburg, Louis: Foreign Bodies of Dental Origin in Air Passages, J.A.D.A., 15:1143-1145 (June) 1928.

PROGNOSIS

According to the authorities herein quoted, the prognosis is good in all cases if the foreign body is expelled or removed early. The gravity of the prognosis becomes more pronounced as time goes on, generally speaking, being directly proportional to the length of time the foreign body remains in the lungs. Early treatment gives every hope of permanent cure, and Jackson is authority for the statement that the mortality is only about 3 per cent in those cases in which the foreign body is expelled or removed, and that without regard to the length of sojourn.

TREATMENT

Statistics tend to prove that only about 3 per cent of all aspirated foreign bodies are coughed up. Jackson writes:

> Waiting for spontaneous expulsion is taking a chance similar to carrying around an appendiceal abscess. The risks are too great to wait for spontaneous cure, which so seldom happens.

Bronchoscopy in skilled hands is recognized today as the best treatment in practically every case. "In the hands of a gentle, careful, thoroughly trained bronchoscopist, bronchoscopy is practically without danger."[27]

CASE REPORTS

CASE 1 (Reported by H. L. E.).—A man under nitrous oxide-oxygen anesthesia, aspirated the roof of an upper molar. Coughing started immediately. The patient expelled the root at the end of twenty-four hours. The only symptom was an irritating, unproductive cough which immediately disappeared after the root had been expelled. Complete recovery with no complications of any kind at once took place.

CASE 2 (Reported by F. M. McClellan).—During an extraction under ether anesthesia, an upper first bicuspid slipped through the beaks of the forceps and struck the dentist's hand. Neither the attending physician nor the dentist saw the tooth enter the patient's lungs. The patient gave no indication of the presence of a foreign body in the lungs. [Lack of immediate symptoms.] Several days after the extraction, the patient had some irritation in the lungs and, after a few spells of coughing, expelled the tooth. There were no bad effects except the irritation of the air passages during the time the tooth was in the lungs. The accident occurred in 1923 and the patient at this time (August, 1929) is in perfect health.

CASE 3 (Reported by Robert I. Humphrey).—A man, aged 41, in good general condition, under nitrous oxide-oxygen anesthesia had the roots of two lower molars removed, with elevators. The operating time was about one minute. It was thought that all roots had been accounted for. When the patient had been awake for a few minutes, he began to cough. He coughed a few times, but got up and left the office and walked back to the shop where he worked. He came to the office a few days later complaining that he must have swallowed something. As his physical condition and appetite were good, he was told not to be alarmed, but to come back in a few days. He did not return again for two weeks, when he came to the office bringing with him the root of a lower molar tooth which he said he had coughed up the night before. A hacking, unproductive cough was the only symptom present at any time. The cough disappeared immediately after the root was expelled. There were no complications and the patient has since been entirely well.

CASE 4 (Reported by A. L. Deeble).—Mrs. K., aged 39, under a general anesthetic had a full upper and lower extraction. An upper bicuspid somehow got by the gauze pack being used and went down the patient's throat. The extraction was finished and the patient's chest roentgenographed. The tooth was found to be in the left main bronchus. The accident happened at 10:30 in the morning, and at 6:30 in the evening of the same day, the patient coughed up the tooth. The cough, which was the only symptom present, immediately disappeared. The patient suffered no ill-effects.

CASE 5 (Reported by Werner J. Pitzen).—Mrs. X., aged 40, had a socket which required suturing and while the suture was being placed, she suddenly aspirated the

27. Footnote 18, second reference.

mouth pack (J. & J.). An effort was made to grasp the mouth pack with a hemostat, but it was too far down the throat. The patient became very cyanotic; being, in fact, blue-black. The operator pulled her forward and struck her a sharp blow on the back and the mouthpack flew out. There were no untoward after-effects.

This case, while not an aspiration accident in the strict sense of the word, illustrates the inadvisability of using mouthpacks that are too small. A small mouthpack, after it becomes covered with

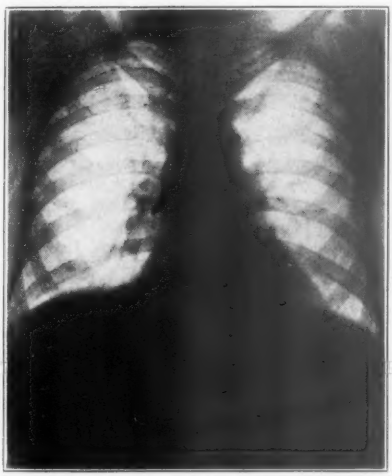

Fig. 3 (Case 7).—Denture in right main bronchus. (Reproduced through courtesy of M. C. Myerson.)

blood and mucus, can very easily slip down the throat and cause trouble by blocking the airway, as occurred in Dr. Pitzen's case.

Case 6 (Reported by M. C. Myerson, M. D.).—On removing a tooth crown from an upper first molar, the crown slipped from the fingers of the dentist. The patient choked and complained of pain in the right chest. Instead of being referred for roentgen-ray study, the patient was advised to "go home and forget it and take a cathartic." At the end of three days, the patient was still experiencing painful cough and had a sensation of something in the right lung. She was referred for bronchoscopy on the third day after the accident. The tooth crown was readily removed by means of the bronchoscope, with eventual recovery.

Case 7 (Reported by M. C. Myerson, M. D.).—A tailor, aged 39, was having a bridge removed and while the dentist was rocking the bridge in an effort at removal, it suddenly came loose and slipped out of his fingers. The bridge disappeared down the patient's throat and he immediately coughed and complained of pain in the chest.

Fig. 4 (Case 9).—Appearance of lungs before artificial pneumothorax. (Courtesy of John Bell Williams.)

He was advised that nothing would come of the accident and was told to go home and take a cathartic. The pain and cough persisted and the patient sought relief from his family physician, who referred him for bronchoscopy. A bronchoscope was passed down the right main bronchus where the bridge was encountered and readily removed. Recovery followed. (Fig. 3.)

Cases 6 and 7 are good examples of aspiration accidents which occurred when no anesthetic of any kind was be-

ing used. This type of accident appears to be rarer than those which occur under general anesthesia. Nevertheless, they do occur.

CASE 8 (Reported by Max Melchior, Copenhagen, Denmark).—Mrs. A. C., Nov. 6, 1924, had all her remaining teeth extracted under ether narcosis. During the narcosis, nothing extraordinary was noticed. After the extraction, coughing occurred and gradually increased, for which reason she consulted a physician. November 12, the patient was obliged to go to bed as she felt very ill. She had a "stitching pain" in the right side of her chest, the cough was intense and there was a high fever. An examination revealed signs of an infiltration of the lungs, the involved area corresponding to practically all of the infrascapular region. In the beginning, the patient did not expectorate, but later there was purulent expectoration which sometimes contained blood. The condition gradually grew worse, with much pain and loss of sleep. The cough grew steadily more painful, was very exhausting and occurred in frequent spasms. December 2, just twenty-six days after the narcosis and extraction, the patient coughed up a decayed cuspid tooth. Her condition rapidly became better and the dullness and other symptoms disappeared. She eventually made a complete recovery and at this time (September, 1929) is entirely well.

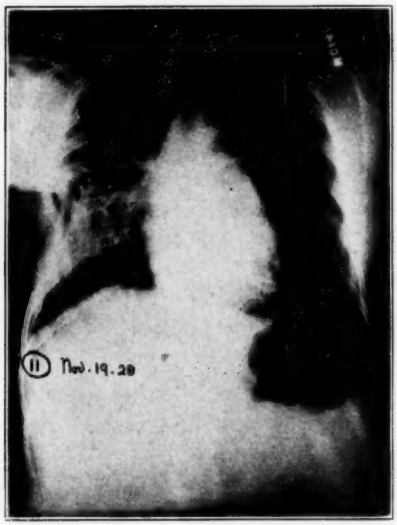

Fig. 5 (Case 9).—Appearance of lungs after artificial pneumothorax. (Courtesy of John Bell Williams.)

CASE 9 (Reported by John Bell Williams).—Miss G. N., aged 21, was admitted to St. Luke's Hospital, Feb. 25, 1928. Seven months prior to admission, while she was in excellent health, her tonsils were removed under general anesthesia. She did not feel well during the week following the operation and, on the eighth day, had a severe pain in the right chest and a temperature of 101 F. She continued to have fever for ten days, when she had a paroxysm of coughing and spit up about a half-pint of foul pus. For a few days, she continued to improve, but she again had fever and was admitted to Memorial Hospital, where a diagnosis of lung abscess was made. She was treated by means of postural drainage and improved for a while, but later lost ground and was admitted to Grace Hospital, where artificial pneumothorax was performed, being continued over a period of several weeks. Since that time, she had had remissions and exacerbations of cough and fever. The sputum was foul-smelling, occasionally streaked with blood and varied in amount up to a pint in twenty-four hours.

On admission to St. Luke's Hospital she appeared ill, the breath was fetid, the expansion of the right chest was diminished and the percussion note from the base upward ranged from flat to dull. The breath sounds were distant and a few coarse râles were heard. There was marked clubbing of the fingers. The laboratory examinations were not important. Roentgen-ray examination revealed an abscess in the right lung surrounded by marked infiltration. (Fig. 4.)

Artificial pneumothorax was again attempted, without success. March 3, the patient was operated on, a window being made in the right axilla and a considerable amount of lung tissue removed with the cautery. After the operation, she improved steadily and was apparently well. About September 1, the symptoms recurred and the roentgen-rays revealed a remnant of the infection in the lower portion of the right lung. A similar operation was performed

at a lower level, and the patient has steadily improved. At this time (January, 1929), she is in excellent general condition and has no symptoms other than a slight unproductive cough. Roentgen-ray examination shows the lungs to be perfectly clear. (Fig. 5.)

This case, while not of dental origin, is included in this report because it illustrates so well the protracted illness of some patients who are victims of aspiration accidents. It should be borne in mind that just such a history as Dr. Williams gives is possible after any aspiration accident from whatever cause; regardless of whether an anesthetic, local

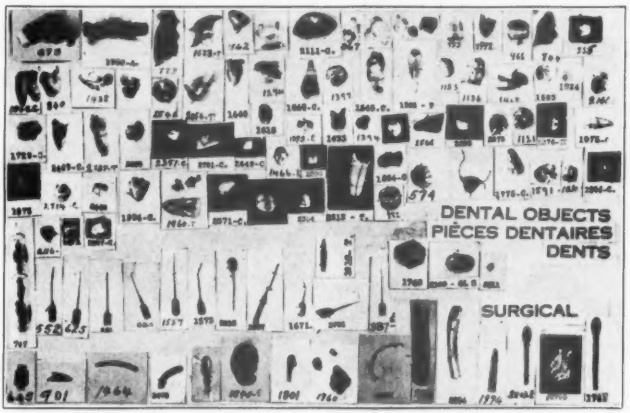

Fig. 6.—Dental foreign bodies removed from the air and food passages by means of bronchoscopy or esophagoscopy. The large variety of objects and the relatively enormous size and the peculiar shape of some of them may be noted. (Reproduced through courtesy of Chevalier Jackson.)

or general, is used, and regardless, too, of whether a solid foreign body or only blood and mucus has been inspired.

Case 10 (Author's case).—Miss J. O., aged 37, April 30, 1928 was referred for the extraction of eight badly infected upper teeth. She was suffering from a severe "pressing" pain in the head, and this pain had completely disappeared when she recovered from the anesthetic and has not since returned. Nitrous oxide-oxygen was administered. The induction and maintenance of anesthesia were uneventful. A striking feature of this case was a profuse hemorrhage which began with the extraction of the first tooth and continued uninterruptedly until after the extraction was finished. So profuse was the hemorrhage that it was necessary to change the mouth-packs several times during the course of the extraction. The changing of the mouth-packs was unavoidable as the hemorrhage was so profuse that work in the mouth was impossible without frequent cleansing of the field of operation.

Just before the last tooth was extracted, the patient began to cough, the cough persisting after she had recovered from the effects of the anesthetic and the mouth had been thoroughly cleansed of blood and mucus. All of the teeth were accounted for by the assistant, but they were checked over a second time because of the cough. No crowns or fillings were missing, nor were any roots broken off and the cough, therefore, was assumed to have started because of the aspiration of blood and mucus. The patient was so informed before she left the office and was advised to watch her condition.

She again came to the office, May 3, and as she was still coughing, she was again advised that the cough was due to something she had inhaled; probably blood and mucus, and that her condition would have to be watched.

May 14, the dentist who had referred the patient stated that she was still coughing. A call was immediately made to the office where she worked and it was found that she was coughing almost continuously (a harsh, dry, unproductive cough). She had a typical "asthmatoid wheeze" (Jackson), which she said had developed a few days after the extraction. There was moderate dyspnea. The patient's temperature was normal and she felt quite well, but "pepless," as she expressed it. She said that when she lay on the right side or back, the dyspnea was aggravated.

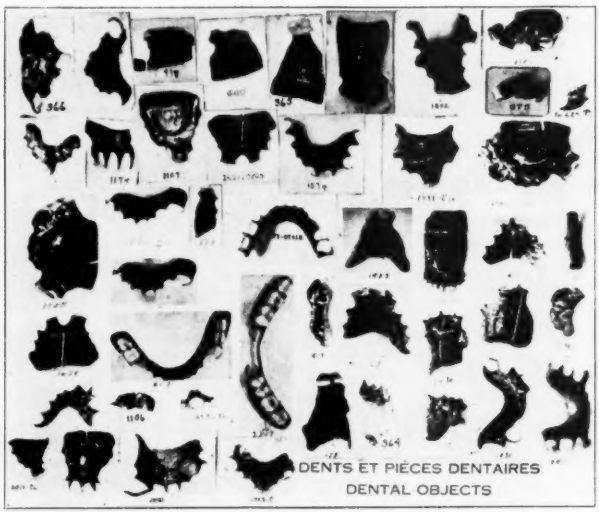

Fig. 7.—Foreign bodies of relatively enormous size. All these objects were removed from the air and food passages by means of bronchoscopy or esophagoscopy. (Chevalier Jackson.)

On being advised to consult her physician, she stated that she had done so about a week previously and that he had told her he thought her cough due to "flu," which was very prevalent at that time. A request was then made from this office that the physician take a roentgenogram of the patient's chest. This was done on the afternoon of May 15, and the films were pronounced "negative" by several physicians who saw them. They indeed appeared to be perfectly normal. May 28, four weeks after the extraction, the patient, after a particularly violent paroxysm of coughing, expelled from the lungs a ball of cheeselike material about the size of a large pea. On rubbing this ball between her thumb and finger, she felt something hard in the center. Examination revealed a tiny piece of bone (alveolar process, tooth structure?) about 1 by 2 by 3 mm. For a matter of twelve hours, the cough seemed less pronounced, but after that time, it continued unabated. By this time, profuse expectoration had developed. The patient was gradually losing weight, but continued to work, although with steadily decreasing ambition.

On the morning of June 2, another roentgenogram of the lungs was made. This was pronounced "suspicious." On the afternoon of June 3, the patient went home and to bed. That evening the temperature was 103 F. (this was the first time a rise in temperature had occurred) and she felt very ill. On the night of June 6, the patient (to quote her literally) "coughed up about a pint of junk." At this time, her temperature was still 103 F. and she did not look at all well. She was urged to have a bronchoscopic examination without further delay, a procedure

which had been insisted on for some time. Bronchoscopic examination was made, June 8. Neither roentgenography nor bronchoscopy revealed the presence of a foreign body. During the bronchoscopic examination, an abscess was opened in the lower lobe of the lung and (according to the patient's statement) "about a pint of pus was sucked out." The patient returned home about June 15. She was coughing up large quantities of mucopurulent material and was feeling quite well and the temperature was about normal. She had up to this time lost about 30 pounds.

The cough continued unabated up to about July 1, when the intervals between paroxysms began to lengthen, the paroxysms of coughing grew shorter and the pus and mucus being expelled from the lungs began to grow less in amount. August 29, the patient again had a rise of temperature and was sent to the hospital. That evening the temperature was 105 F., and the patient looked and felt very ill.

On the evening of September 1, she was feeling pretty well, but was again coughing up large quantities of pus. The physician decided to have another bronchoscopic examination made, but on account of the serious illness of her mother, the patient left the hospital and returned to her home. On the evening of September 22, she expelled from her lungs (at least, she claims to have done so) the tip of a tooth root about one-fourth inch long. This root tip bore a striking resemblance to the tip of the root of a lower first molar. At the same time, there was a large amount of pus expelled. From this date on, the patient's condition gradually improved and, at the present time, August, 1933, she is apparently perfectly well.

CONCLUSIONS

1. The possibility of an aspiration accident occurring during the course of any dental operation is too infrequently stressed in dental literature. Such accidents do occur, although very infrequently in the practice of individual dentists. These accidents should be looked on as one of the potential hazards accompanying dental practice, either general or special.

2. The percentage of aspiration accidents of purely dental origin is very small when compared with the thousands of dental operations performed every day. Of aspiration accidents from all causes, those of purely dental origin comprise, roughly, about 4 per cent.

3. The possibility of an aspiration accident occurring, even though that possibility is exceedingly remote, should be a stimulus to the greatest care in operating in the mouth.

4. As only about 3 per cent of all aspirated foreign bodies are coughed up, and as their continued sojourn in the lungs is fraught with great possibilities for harm, they should all be removed as soon as possible after their discovery.

5. Delay is dangerous. For that reason, deferred or expectant treatment should not be considered.

6. Symptoms usually, although not always, occur immediately. The principal symptoms are cough (at first unproductive), dyspnea, and an asthma-like wheeze (the "asthmatoid wheeze" of Jackson). In rare cases, pain occurs as an immediate symptom. Lack of symptoms is not proof that the foreign body has been swallowed rather than aspirated. This is especially true of non-obstructive metallic objects.

7. The slightest suspicion that a solid foreign body has been aspirated calls for immediate roentgen-ray examination. If this examination is not conclusive, bronchoscopy should be performed for purposes of diagnosis. If the foreign body is discovered during the bronchoscopic examination, it is, of course, removed.

8. There is but one treatment worth considering in practically all cases when once the presence of a foreign body has been definitely established. That treatment is bronchoscopy at the hands of a

thoroughly trained and experienced operator.[28]

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THE HUDSON COUNTY PLAN FOR MEMBERSHIP: A PLAN WHICH SUCCEEDED IN ORGANIZING A LARGE COUNTY 95 PER CENT

By WALTER A. WILSON, D.D.S., Jersey City, N. J.

RECOGNIZING thorough organization to be the keystone in the defense of the traditions of dentistry and in the progress of our profession, the Hudson County Dental Society of New Jersey launched, in October, 1932, an inspired membership drive. Early in 1933, the drive was completed and with such success that the details of the method used should be of value to other societies.

The idea of enlisting in our society every dentist in the county was not merely a passing fancy for having a large society but was part of a well thought-out plan. Having an active organization of about 230 members in a cosmopolitan community in which about 350 dentists were licensed, we had been successful in upholding the standards of dentistry. As happens in other urban centers, we were beset by numerous problems affecting economically and otherwise the welfare of our members and our profession. Through the active efforts of our organi-

zation, the cooperation of our state society and the state board, we were able to meet some of these problems, chief among which was that arising from the extension of the activities of unethical dentists. Through state board action, the wings of some of the flagrant offenders were clipped; but in legislative matters along these lines we were not so successful.

With the report of the committee on the costs of medical care came the subsequent outburst of literature warning the professions of the threat of socialization. The general economic conditions so affected the temper of the people that we were ready to expect anything. In any event, the safest procedure was to be prepared. Without nearly 100 per cent membership, we could not hope to withstand outside attack; we must have an organization that really represented the great majority of the profession. To this end, we bent our unceasing efforts and we obtained success only in exchange for hard work.

THE PLAN

The first step was to appoint a general chairman of the membership drive committee, with full power to organize and conduct the drive. For this position, we needed a man who was thoroughly aroused to the need for organization, an energetic worker with pleasing personality and some oratorical skill and possessed of a knowledge of economic, political and professional reasons for organization. Every society has some member or members who can to some degree fill this bill. We were undoubtedly most fortunate in finding in our chairman, Louis Brach, of Jersey City, all of these requirements. While Dr. Brach was organizing his committee and making surveys, recording statistics, etc., our ethics committee did some housecleaning. The drive committee consisted of a representative from every small geographic section of the county; necessarily a large committee. The survey yielded the following: licensed dentists, 350; members, 230. Lists of nonmembers were compiled and distributed among the committee.

HOUSECLEANING

Before the committee went to work, the ethics committee cooperated by putting our own house in order. At a special meeting, specific, uniform regulations of signs, which eliminated all that was obnoxious in the outward appearance of members' offices, were unanimously adopted. Within thirty days, the regulations were in strict enforcement. This was an important step in the plan, for it enabled us to approach a prospective member with definite stipulations as to signs and to point to his neighbor as an example of complete cooperation.

Our bylaws were suspended by special ruling to permit members in arrears to resume membership without full penalty.

THE ATTACK

The chairman organized his committee of active workers who were familiar with organization activities. They were given thorough instruction as to the arguments to be used in soliciting new members. They were reminded of the threats of outside interference in our profession, of socialization, insurance dentistry and clinics of doubtful management; of the experiences of the profession in other countries; of how organization in France helped to procure a better deal than in other countries. They were reminded of the legislation procured by organization and the better legislation that could be secured by better organization. They were told of the responsibility of every member to his profession and of the scientific advancement made possible only

through organization. Magazine articles that would carry weight were called to their attention for use in talking with prospective members. They were warned of the dangers confronting us if we failed to meet our responsibilities. It was a well-informed, militant committee. The argument of liability insurance protection was withheld, the committee desiring to enlist men more for what they could contribute than for what they could gain.

"PUSH-OVERS"

In the vernacular of the day, a large number of the nonmembers were "push-overs" needing only an invitation to join or rejoin. As in all societies, through the years, many had been permitted to be dropped out or to resign for little or no cause, without protest from the society. These were quickly enlisted. Some others who had shown no interest became interested and convinced of the need for organization when called on by the local committee member. Others resisted and some resented their neighbors urging them.

FLYING SQUADRON

When a repeated visit of the committeeman failed to enlist a prospect, a group of two or three past presidents or other men of known standing, preferably two, and usually including the chairman of the committee or the president, visited the man, by appointment as a rule, and had a heart-to-heart talk with him. An added argument was presented in showing that the dentists of the county were now divided into three groups: (1) ethical dentist members; (2) ethical dentist nonmembers, and (3) the out-and-out advertiser. It was shown that most of group 2 were now members, and the prospective member usually wanted to join the ethical dentists who were members, to avoid being among the few who, with the advertisers, were outsiders.

ADVERTISERS AND SEMI-ADVERTISERS

Our county, being a cosmopolitan, manufacturing center, we were possessed of many flagrant advertisers. In some sections, men who otherwise wished to conduct themselves ethically felt compelled to use unethical displays and methods. Criticism from some quarters was ignored when we brought these men into line. Our contention that a man who expresses his desire to abide by our code should be given the opportunity has been borne out in that these men have made enthusiastic members.

In the case of the known advertiser, who, as the movement progressed, asked admittance, he was told to conform to our code for a period of months. A special committee talked with him and learned his views. He was given no definite assurance of acceptance. When the ethics committee deemed advisable, he was recommended. Attendance at meetings during probation was insisted on.

GROUP MEETINGS

In some sections or towns, group meetings were held. Social evenings to which all members and nonmembers of the locality were invited, together with some of the outstanding men of the county, who addressed the meetings. Round table conversations over a sandwich and a glass of 3.2 helped greatly to make some men appreciate the advantage of cooperation, organization and comradeship.

OTHER DETAILS OF VITAL IMPORTANCE

As this drive was progressing, the other activities of the society were dovetailed into the picture.

The monthly bulletin of the organization, established the year before, published editorials and articles on the progress of the drive, the need for organi-

zation, etc., and announced programs for the meeting that were unique and interesting. Men of attractive personality and high rank addressed our meetings each month and, by request, incorporated in their talks strong pleas to every dentist to join the ranks of the A.D.A. Prospective members were invited and urged to attend our meetings and were often escorted by a member of the committee.

The regular membership committee had its work cut out for it. Applications obtained by the drive committee were turned over to the regular membership committee and thoroughly rechecked as to ethics and qualifications before being acted on by the membership.

Men were not permitted to join by proxy, but were required to be inducted at a regular meeting according to a regular ritual, and to sign an oath of membership. In this way, the old custom of men joining a society but never attending a meeting is no more. A man is received and given the glad hand. He gets the spirit of the thing and is likely to continue in that spirit. Our attendance at meetings continues to register more than 200 a month. The ritual and the oath of membership follow:

RITUAL

Dr.....

The members of the Hudson County Dental Society have seen fit to elect you to membership in our Society. By this election you also become a member of the New Jersey State Dental Society and of the American Dental Association, the greatest dental society in the world. This is, indeed, a great honor.

It is my privilege, as president, in behalf of our members, to welcome you to our Society, feeling that we, as well as you, will profit by this new association.

Our Society has a definite purpose in the scheme of life, being primarily to cultivate the science and art of dentistry; to elevate and sustain the professional character of dentists, and to promote amongst them mutual improvement, social intercourse, good will and self protection. In order that these objects may best be attained, it is necessary that we subscribe to and abide by the Constitution, By-Laws and Code of Ethics which have been adopted by the Society. . . .

OATH OF MEMBERSHIP

Having been duly honored by election to membership in the Hudson County Dental Society, I hereby give my solemn oath that I will observe, support and be governed by all the provisions of the Constitution, By-Laws, and Code of Ethics, as adopted by the Society, and to support the honor and dignity of the dental profession, and discharge the duties of a practitioner with fidelity and integrity.

I will abide by the decisions of the Ethics Committee in all matters pertaining to the regulation of ethical conduct and further promise not to indulge in any form of advertising whatever, restricting myself to only those forms of simple announcements which are essential and such small name-signs as are necessary for identifying my office.

Fully appreciating my responsibility to my Society, my profession, and to the public which it serves, I hereby place my signature to this oath.

Signed .....

Other activities during the year which kept up the enthusiasm consisted of surveys of existing dental clinics and activities by the society in legislative endeavors. Thrashing out controversial questions to a satisfactory conclusion on the floor of our meetings creates enthusiasm and increases attendance and membership. It shows that the organization is alive.

CONCLUSION

The successful conclusion of this plan, together with recommendations offered to insure continued strength, is best set forth in a report of the committee as of February, 1933, which is presented herewith. The figures are incomplete to date, as we have now enlisted all but 5 per cent of the eligible dentists of the county. Conditions vary in different sections of the country, but it is our conviction that since success was possible in our cosmo-

politan section, under greatly adverse conditions, it should be possible in every component society in the country. If the effort is conscientiously made, the A.D.A. will within one year constitute a very large percentage of the dentists of the country, and with such a representative organization, there is no problem that we could not solve, no attack that we could not withstand.

The report made by Dr. Brach to the Hudson County Dental Society, follows.

REPORT

The Special Membership Drive Committee started with a list of 123 names of dental licensees in Hudson County who were not affiliated with the Hudson County Dental Society. With a few exceptions every single man listed was visited personally by a member or members of the Committee, with the following results:

Nineteen were found to be practicing in other jurisdictions.

Sixty-nine have affiliated.

Eighteen refused to affiliate.

Three were anxious to affiliate, but did not because of lack of funds.

Eight were ethical practitioners, but barred because of racial distinctions.

Six were barred because advertising or working in advertisers offices. Total, 123.

In addition to the mere mechanics of soliciting membership, the committee has endeavored to uncover the reasons for so many ethical practitioners remaining aloof from organized dentistry, with the thought of making it forever unnecessary for this society to again need a membership drive. As a result of these investigations, the following recommendations are submitted to the society for approval and immediate action.

1. Entirely too many of the young practitioners visited felt absolutely no urge to affiliate with organized dentistry. Harry Bull has made the excellent suggestion that our society immediately establish contacts with the deans of neighboring dental schools and urge that, commencing with the freshman year, students at these schools receive some lectures upon the necessity and value of A.D.A. affiliation. If this additional emphasis upon organization is maintained throughout the entire course, the young graduate is more than likely to voluntarily seek affiliation. The committee so recommends.

2. Harry Lenz has suggested that this society each year obtain a list of the New Jersey residents of the senior classes of the neighboring dental schools and invite them, by means of form letter, to attend our monthly meetings. The committee recommends this be done.

3. The committee further recommends that immediately following the publication of the list of the successful candidates at the state board examinations, our regular membership committee immediately get in touch with such licensees as reside in our jurisdiction, invite them to meetings and make every effort to encourage their affiliation with our society.

4. In going from one end of the county to the other, no one thing stood out more than the deplorable financial condition of a goodly number of the dentists visited. As enumerated above, quite a few men, although desirous of affiliation, were restrained from doing so because of their inability to pay the $12 dues. Your committee feels that these men should be helped—at least for the duration of the present emergency. It therefore recommends the setting aside of a small amount of money, say, $200, in a special fund to be administered by the president, to be used to pay the dues of such individuals to our society. Notes may be taken for the installment repayment of the loan without interest. This

fund could also be used in similar fashion to help those of our members who, on each February 15, are found, on adequate investigation, to be unable to pay their dues and hence in danger of suspension.

5. Of the sixty-nine dentists who have affiliated with us as a result of this drive, a surprisingly large percentage, roughly a third of the total, have been members of our society at some time in the past, but have been dropped for nonpayment of dues or been permitted to resign. If we mean what we say when we state that the profession needs the cooperation of every single ethical practitioner in order to combat the various evils facing dentistry, we assuredly convict ourselves of extraordinary negligence in having permitted so many men to sever their connections with us. It undoubtedly accounts for the fact that, in spite of steady election of new members each month, our membership roll is today just about what it was ten years ago.

The Committee therefore recommends that

(A) In the future, no request for resignation be accepted without adequate investigation, and

(B) Two weeks before the clause in our bylaws suspending for nonpayment of dues becomes automatically operative, a list of the unpaid members be sent by our treasurer to the membership committee, whose duty it shall be to visit each delinquent member personally, to:

(*a*) Get him to pay his dues, if possible, or

(*b*) If this is impossible, arrange that he be helped by the fund mentioned in recommendation 4, or

(*c*) If this is declined, get his resignation, that he may part from the society clear as to record on our books. To accomplish this, it will be necessary to amend our bylaws, changing the suspension date from February 15 to January 1.

6. Again, if we mean what we say when we ask for the cooperation of all ethical practitioners, we cannot defend our present policy of barring for racial reasons members of our profession who have, throughout their entire professional careers, practiced in the most ethical manner. Your committee recommends that these men be encouraged to affiliate with us.

7. A special effort was made to discover the reason or reasons that so many men, for other reasons than nonpayment of dues, have dropped their membership over the past years, and the answers were illuminating enough to suggest the formation of a grievance committee composed of two men from each of the four large divisions of the county. Many little things have occurred in years past, things too small to be dignified by referring them to the ethics committee, and yet important enough to cause these men to resign. A grievance committee could very easily iron out such difficulties and hence the committee recommends its formation.

8. To destroy forever the idea still unfortunately held by some few men that a "clique" runs this society, the committee recommends that, through the medium of the bulletin, the general membership, each year before the annual Election, be encourged to send in to the nominating committee the name or names of those men from their section of the county whom they wish to see nominated for offices in the society. The standard of course is to be service to dentistry in general and to the society in particular. This would be helpful to the nominating committee. The names of the men who remain unselected might well be turned over to the incoming president and serve as a source for drafting men for important committee appointments.

If the above mentioned recommendations are carried out, the committee feels that the leaks which have accounted for the loss of members over past years will be stopped and machinery provided that will assure the continued and steady growth of this organization over coming years.

This report was accepted and the recommendations therein were adopted.

A NEW PRINCIPLE OF CONSTRUCTION FOR ANTERIOR BRIDGE ABUTMENTS

By WALTER E. JONES, D.D.S., St. Paul, Minn.

THE need for a more successful preparation which is especially strong and adaptable to thin anterior teeth, in restorations and in the construction of anchorages for bridge abutments is more apparent as time goes on.

Following is a description of a preparation which has been used successfully for several years, not only on thin teeth but also on all types, regardless of the intermaxillary relationship.

The principle of this preparation is to utilize all the available tooth structure possible by having the retention at the periphery of the preparation, so that the tooth is grasped labially from the contact points and on the incisal edge, thus securing the maximum amount of anchorage.

PREPARATION TECHNIC

1. Disks are used to remove the bell of the tooth on the mesial and distal surfaces, leaving them parallel or very slightly converging toward the incisal aspect.

2. Stones are used to remove enough of the tooth structure on the lingual surface to allow for clearance of the bite and a sufficient thickness of gold.

3. Before any tooth structure is removed from the incisal edge, a carborundum disk is used to cut on the labial surface, parallel to the incisal edge and 1 mm. therefrom, a groove which is parallel to the enamel rods in that area to the depth of 0.5 mm. Holding the disk at right angles to the long axis of the tooth, the operator removes 0.5 mm. from the incisal edge. Then, with a disk held parallel to the labial surface, he removes that portion of tooth structure between the groove and the incisal edge, forming a step, the incisal portion of which should be slightly rounded. (This means that the restoration here will show approximately 1 mm. of gold, the appearance of which can be greatly improved esthetically by a rounding of the incisal edge labiolingually.

4. A groove is made on the mesial surface by holding a carborundum disk at a 45 degree angle to this surface (parallel to the enamel rods), joining the lingual wall of the incisal step with the mesiolabiogingival point angle and sinking the disk directly to the lingual aspect of the mesiolabial line angle. The groove should be 0.5 mm. deep at the incisal end and, owing to the curvature of the labial surface, should fade out at the gingival end. This operation is repeated on the distal surface, these grooves being kept parallel

or slightly converging toward the incisal.

This principle of construction may be used in the same way on posterior teeth, the retention being maintained at the periphery of the preparation.

Some of the advantages of this type of preparation are:

1. There is an almost entire freedom from pain owing to the position of the grooves.

2. There is a minimum amount of tooth destruction consistent with maximum strength and extension for prevention.

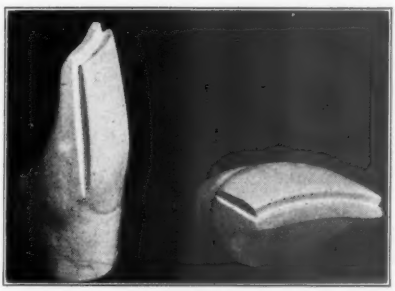

Fig. 1.—Two views of grooves.

3. The incisal edge of the tooth is not weakened by the preparation, and the thickness of the gold assures a bridge that will stand the forces of mastication.

4. It reduces the distance from the point of stress to the point of resistance to a minimum.

5. The clasp grips the larger portion of the tooth, and thereby a decidedly strong anchorage for bridge abutments is assured.

6. It is suitable for all types of teeth, thick or thin, short or long, either upper or lower, regardless of the bite. It is especially indicated for thin teeth, and also for lower anterior teeth because of the direction of the stress in that region.

7. It does not leave weakened or unsupported enamel.

8. The technic is simple. The area in which the grooves are placed is easily accessible and the grooves need not be so deep.

9. The pulp is conserved. Owing to the position and depth of the grooves, no pulp irritation is caused during the preparation nor is the pulp endangered by thermal changes after the restoration is completed.

Fig. 2.—Completed case.

The only objection to this type of restoration is that a little more gold shows on the incisal edge than is desired for esthetics, but in view of the sad effects of a few years of service in cases wherein little or no gold was exposed, the added strength surely seems worthy of the sacrifice of esthetic values.

INDICATIONS FOR FIXED BRIDGEWORK AND CONSTRUCTION OF ABUTMENT PIECES*

By ROY JAMES RINEHART, D.D.S., F.A.C.D., Kansas City, Mo.

BRIDGE construction is probably receiving more attention than any other branch of the art of dentistry. Modern bridge construction is a unique mechanical procedure, representing an assemblage of a great mass of ideas of many men of an inventive and artistic turn of mind.

If we turn our thoughts to the methods used a few years ago and compare them with those now in use, the progress evident is very gratifying. Accurate procedures in abutment and pontic construction have taken the place of the making of band crowns and soldered pontics which were much less satisfactory. With the present methods available to all operators, there is no excuse for unsanitary and irritating crowns and bridges.

In considering any of the branches of dentistry, a knowledge of the normal is necessary. Upon this basis rests the recognition of the abnormal. It is not within the scope of this presentation to elaborate on the subjects of anatomy and histology, but an understanding of these subjects is necessary if the practitioner is to render his service capably. The present understanding of periapical and periodontal diseases assures a healthy foundation upon which to build the bridge, but the success of the bridge depends on the health of the mouth. A bridge which is accurately constructed and placed in the mouth cannot be a success if periodontal conditions exist adjacent to and about the abutment teeth. Therefore, the recommendation for a bridge must depend on a sound diagnosis and prognosis.

An accurate survey includes both a roentgenographic and a clinical study of the mouth as a whole. Study casts made of artificial stone are desirable for accurate study of the case. The casts should be mounted upon an anatomic articulator to determine the relationship of cusps and planes during their natural movement. A failure to establish functional occlusion and harmony of the entire masticatory apparatus will be lacking if this procedure is not followed. A study of occlusal relationship is made to determine whether the bite should be readjusted. The procedure of making study casts does not necessarily apply to replacements by small bridges inserted immediately after extraction, but does apply to all neglected mouths or extensive plans of restoration.

In referring to readjusting of the bite, I wish to register my protest regarding excessive practice of this procedure. Readjusting the bite in some cases does much for patients, but it is my observation that some patients have been subjected to a very severe ordeal and the end result is uncomfortable and not practicable.

*Read at the Seventy-Fifth Annual Session of the American Dental Association in conjunction with the Chicago Centennial Dental Congress, Aug.

FIXED BRIDGE INDICATIONS

The problem of selecting a fixed or removable appliance for restoring lost teeth is a matter of judgment and experience. Many operators overlook the opportunity afforded for study and observation in the cases that have proved failures, and thus fail to develop judgment in the selection of the type of restoration that will prove satisfactory in a given case. One who has conscientiously studied his past failures in bridge restorations, and determined the cause of failure, will be in possession of a vast store of knowledge to guide him in the selection of a fixed or removable type of bridge. To fail to observe the reason for a certain type of bridge proving unsatisfactory can result only in one thing—the needless condemnation of one type or the other. Both types of bridges have their place, and there are certain indications for each. Generally, the factors to be considered in making this decision depend on (1) the health of the mouth and teeth; (2) the extent of the bridge restoration, and (3) the desire of the patient in the matter of mutilation of sound teeth for bridge abutments.

The first two mentioned are a matter of proper diagnosis and experience. It is needless to say that all teeth that are to serve as bridge abutments should be sound and vital, with the investing structures, both alveolar process and gingival tissues, in a healthy condition. To place a bridge restoration on a faulty tooth is to invite disaster, for such a bridge can no more be a success than can a bridge whose piers are placed in quicksand. The mechanics of construction demand that firm, substantial foundations be built for all structures, and the dental bridge is no exception to this postulate of engineering. Occasionally, in the case of a pulpless cuspid or central incisor that is uninvolved with periapical disturbances, and has a properly filled root canal, such teeth can serve as an abutment for the placement of a Richmond crown, which, if properly constructed, serves as a substantial anchorage.

The second factor in deciding the type

Fig. 1.—Conservative spaces for fixed bridgework.

of bridge is the extent of replacement of missing teeth. Unilateral cases with only two teeth missing should not be replaced with removable bridges, but the fixed type of restoration should be employed. Cases of extremely close bite should be restored with fixed bridges, as this type will prove more substantial and give better service. For extensive restorations, partial dentures are more favorable.

The third consideration in the selection of the type of bridge is the item of mutilation of sound teeth for abutments. This is purely an esthetic consideration on the part of the patient and should be subordinate to the greater need of selecting the bridge type that will give the greatest service.

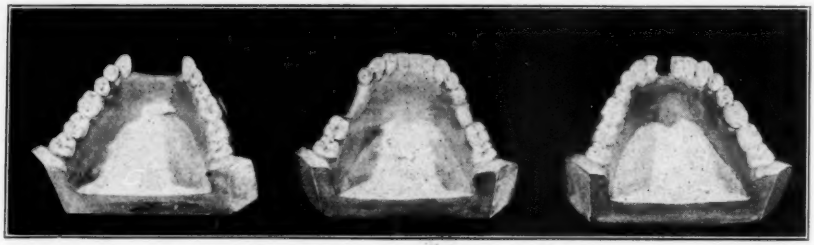

Fig. 2.—Conservative spaces for fixed bridgework.

PREPARATION OF THE MOUTH AND ABUTMENT TEETH

No careful operator will begin a piece of work without first cleaning and polishing all teeth thoroughly and putting the mouth in a healthful condition. All fillings should be removed in the abutment teeth to ascertain the condition of the pulp and to assure against the presence of decay. After the cavity is cared for with excavators and burs, it should be sterilized and filled with cement. Copper cement is preferable, but it cannot be used in abutments that are to receive partial or three-quarter veneer crowns because of discoloration.

If a full gold crown is to be used, the cavity may be lined with copper cement and finished with amalgam. Before setting the crown, the operator should be sure that the two metals do not make contact because of the possibility of electric shock. If the cavity is lined with cement and there is also a layer between the amalgam and the gold, there will be no danger.

TYPES OF ABUTMENTS

From observation, it would seem that the majority of the abutments used are three-quarter or partial veneer crowns. It is this type, with various modifications, that this paper will consider more fully.

With the recent improvement in investments and casting technic, inlays and crowns may be made nearly 100 per cent perfect. This progress is most gratifying. The types of abutments are the full gold crowns, inlays, pinlays, Richmond crowns and open face crowns. There are many variations of these types and all developments are making fixed bridge construction more successful. The great majority of preparations are made on vital teeth; therefore, extreme care is necessary to avoid frictional heat and mechanical shock, and also close proximity to the pulp.

In all cases of preparation on vital teeth, a minimum amount of tooth structure should be removed.

ANTERIOR THREE-QUARTER OR PARTIAL VENEER CROWN

Many partial veneer crowns on anterior teeth have failed owing to faulty preparation and inadequate consideration of the more unfavorable conditions, such as closed bite, the presence of large cavities and tipped and rotated teeth, and other abnormal conditions. Preparation of the teeth must be made to bring out parallelism. A parallelometer is not necessary with the trained eye in the majority of small cases, but is usually necessary when a bridge with three or four anchorages is constructed.

A vivid mental picture of the finished preparation is necessary to begin with, for effective results in any mechanical procedure. The first procedure in the preparation is to parallel the mesial and distal walls. Then the grooves are made and paralleled and extended from the incisal just back of, and parallel with, the labial plate of enamel, extended within 1 or 2 mm. of the termination of the enamel at the gingival aspect, and the groove is made sufficiently deep to assure a firm and strong anchorage.

When a casting is seated, if it is to be successful, it will have mechanical stability. It should go to place with thumb pressure and be somewhat difficult to remove with the aid of an instrument. A loosely fitted or tapering casting is doomed to failure.

A groove should not be extended into a cement filling, as there is no permanent anchorage by this means.

Figures 1-2 indicate the conservative spaces for fixed bridgework, the longest space being from cuspid to cuspid or a six tooth bridge. In the posterior spaces, a four tooth bridge is indicated.

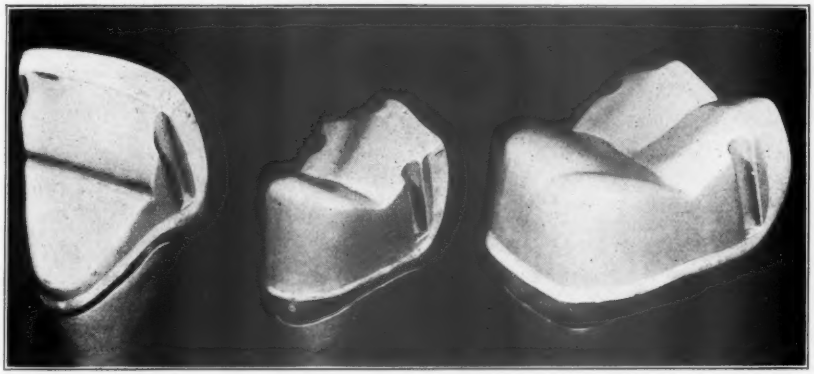

Fig. 3.—Preparation of upper central incisor, bicuspid and molar.

Figure 3 shows a preparation of an upper central incisor, bicuspid and molar. This illustration, to a certain extent, indicates a shoulder, but, on careful examination, it will be noticed that it is a distinctive bevel. The groove mesiodistally across the lingual portion of the anterior tooth is necessary for adequate strength. The gold should extend completely over the incisal aspect of the tooth, but, with a bevel preparation, little gold should be visible. Whether the gold extends to the labial, mesial

or distal aspect will depend on the shape of the tooth and the extension of the bridge.

The occlusal preparation of bicuspids and molars should follow the planes as indicated in the cut, and sufficient gold should extend over the enamel edge of the buccal cusp to assure its protection. Grooves must be parallel and of sufficient depth for strength. Grooves should be made with a straight fissure bur, No. 558 or 559.

Figure 4 shows slight variations of the preparations for the upper cuspid. In the first cut, it will be noticed that, in place of a groove, a box shaped cavity has been formed in the tooth, indicating that decay was removed from the proximal surface. A preparation for a pin in the lingual sulcus adds to the anchorage of the casting.

The second preparation indicates the most logical place for the groove across the lingual surface, which greatly adds to the strength of the anchorage. The cusp should be well protected with gold and beveled as indicated. The third and fourth preparations are identical, except that one shows a distinct labial bevel on the incisal edge.

Figure 5 shows the preparation for the lower molar, first bicuspid and lower incisor. The bevel on the cusps for the lower molar and first bicuspid should be such that the cusps are well protected. The anchorage extends entirely over the cusp. Because of the thinness of the lower central incisor, proximal grooves are not indicated in the majority of cases. Therefore, if the mesial and distal preparations are parallel and slightly beveled, the anchorage will be sufficient when one or two incisors are supplied. Lower fixed bridges should always have two anchorages.

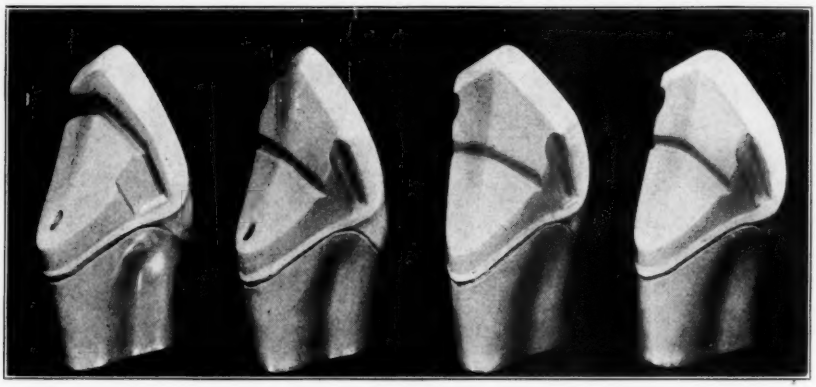

Fig. 4.—Slight variations of preparations for upper cuspid.

Figure 6 shows a preparation made over the anterior half of a molar. This type of abutment is strong and preserves the natural contact point of the tooth. It has fully as much anchorage as a full gold crown. The preparation is made by removing the enamel from the buccal, mesial, distal and occlusal anterior portion of the tooth. Grooves are extended bucally and lingually. The preparation is extended distally into the sulcus of the

tooth as would be indicated for an inlay, the finishing line being on the inclined plane of the cusps. This type of preparation may be used in the stress-breaker type of bridge when the first molar has been lost, employing a rest on an inlay which has been placed in the second bicuspid.

INLAY ABUTMENT

The inlay for an abutment has told its own story to the majority of operators. When it is cemented within the dentin, the leverage soon rocks it loose or splits off a portion of the tooth.

Many ideas have been suggested regarding the use of the inlay, such as extending pins or screws through the inlay into the dentin; but they are without noted success. The possible exception of an inlay abutment is the extensive mesio-clusodistal restoration.

The inlay is successful as a receptacle for the lug or pin in the stress-breaker type of bridge. This kind of bridge is strongly recommended. Fixed anchorage bridges that failed, when remade into stress-broken bridges gave results that were gratifying.

GOLD CROWN ABUTMENT

The abuse of the shell crown brought bridge construction into a new era. So thoroughly has the ill-fitted crown been condemned that the dental profession has had great difficulty in convincing the medical profession that a gold crown of modern construction or a band crown accurately made is no more of a menace than is a partial crown. The preparation for the gold crown may be less than for any other type. If the crown is cast, the pattern should be made as thin as possible to avoid thermal shock.

The preparation for the cast gold crown may terminate at any place on any side the tooth. It is better not to extend it under the free margin of the gum. If the preparation is terminated at any point, it is not necessary to slice away the bell portion of a tooth. The important thing is to establish a finishing line definitely and cast a crown that will go directly to place with thumb pressure.

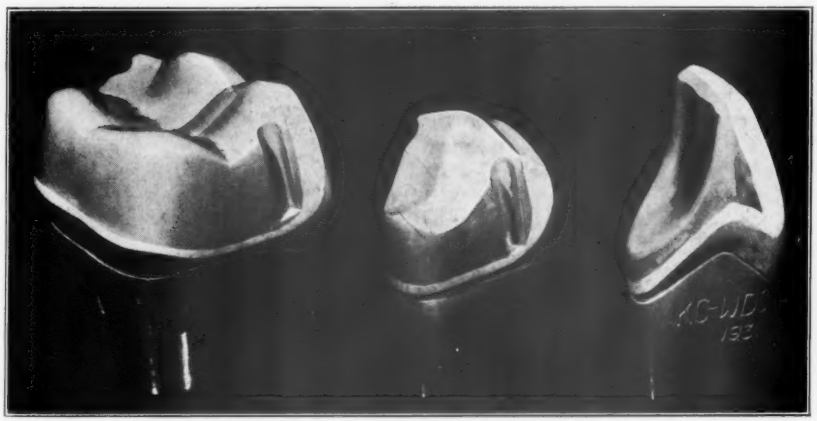

Fig. 5.—Preparation for lower molar, first bicuspid and lower incisor.

The greatest value of the properly constructed gold crown is the strong anchorage that is afforded by this type of abutment, the strongest type of anchorage to be had.

As a precautionary measure, all exposed dentin should be immediately protected after the preparation is completed. Before the gold crown is set, the dentin may be sterilized with nitrate of silver solution.

RICHMOND CROWN AND OPEN FACED CROWN

The Richmond and the open faced crown still have their place in bridge construction. If the dentist is in favor of 100 per cent vital teeth, the Richmond crown has no place; but, in the case of a nonvital cuspid, it has no equal for efficiency and esthetic values, if accurately constructed.

The open faced crown with a cast back is suitable as an anchorage in many cases, such as that of a lower cuspid, and often is very successful on a short upper cuspid. The lower cuspid anchorage may be a wide band effect, with the entire cusp of the tooth uncovered. Every one of us has seen these types give long service when properly fitted; but their use is rather limited and fulfils requirements only occasionally.

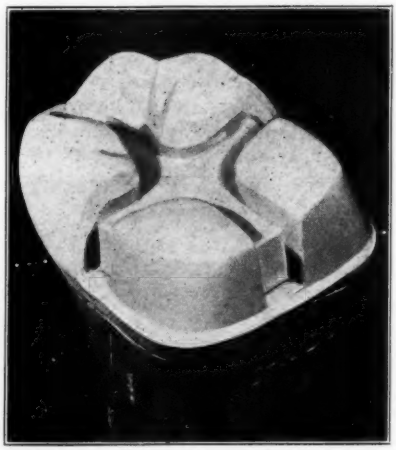

Fig. 6.—Preparation made over anterior half of molar.

ULTRAVIOLET IN DENTISTRY*

By ALBERT BACHEM, Ph.D., Chicago, Ill.

THE therapeutic importance of ultraviolet in dentistry is becoming more and more appreciated, but the mechanism of its action is not yet well understood. An extensive study of the fundamental facts may help to clarify the situation.

The visible spectrum comprises light rays from a wave length of about 390 to a wave length of about 770 mμ. Rays of longer wave length than 770 mμ, called infrared rays, produce physiologic effects only by the production of heat. Rays of shorter wave length than 390 mμ are the ultraviolet. These rays exhibit great chemical activity, by which they produce

*From the Department of Physiology, University of Illinois.

*Part of this investigation was made under a grant from the Council on Physical Therapy of the American Medical Association.

*Read at the Seventy-Fifth Annual Session of the American Dental Association in conjunction with the Chicago Centennial Dental Congress, Aug. 10, 1933.

a great variety of physiologic effects. In order to produce those effects, the rays must first be absorbed and their energy be utilized for the production of chemical changes. The absorption of ultraviolet rays by various substances varies enormously throughout the ultraviolet spectrum. Generally speaking, one may state that the long wave ultraviolet, from 390 to about 310 mμ, has great penetrating power, not much different from that of the visible rays. Correspondingly, these rays cause little chemical and physiologic effect. From its position close to the visible area, this part of the spectrum is called the near ultraviolet. On the other hand, the rays of a very short wave length, shorter than about 230 mμ, have little penetrating power, through most optical mediums as well as through biologic tissues. Those rays usually do not penetrate far enough into the organic structures to produce any biologic effect. That part of the ultraviolet spectrum may be called the far or extreme ultraviolet. Between these two areas, there exists a region with rays penetrating deeply enough to reach the living tissues of organisms, but absorbed enough to produce chemical and physiologic effects. In this area around 300 and 250 mμ, therefore, we find the greatest biologic effectiveness of the ultraviolet rays. These rays are usually called the actinic.

Until recently, little was known quantitatively about the penetration of ultraviolet light into the tissues. The figures as given in the literature varied between a transmission of 0.01 per cent through 0.1 mm. of human skin, as determined by Hasselbalch, for a wave length of 289 mμ, and 56.3 per cent through 1.2 mm. of rabbit skin, as stated by Anderson and Macht for 280 mμ. In order to establish accurately the ultraviolet transmission through the skin, a preliminary investigation[1] was undertaken to determine whether dead skin could be substituted for living skin and how the specimens should be treated in order to approximate living skin as closely as possible. This work proved that little difference in transmission exists between live and dead tissue for the first few hours after death if the skin specimens are kept moist by Ringer solution and well stretched in a frame. An incidental observation made in the process of this work revealed the

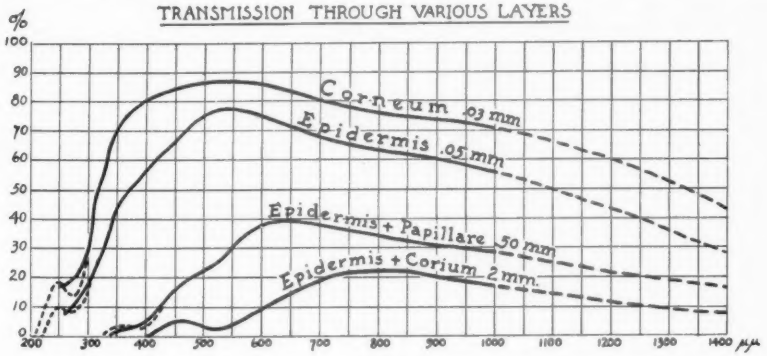

Figure 1.

1. Bachem, Albert, and Reed, C. I.: Am. J. Physiol., 90:600 (Nov.) 1929.

TABLE 1.—PERCENTAGE OF TRANSMISSION

Specimen Thickness (Mm.)			Cantharides Blister			Cantharides Blister		Skin		Skin		Groin			Skin + Fat		
			0.03 Corneum	0.03−	0.03+	.05− Epidermis − Germinat.	.05+	.5− Epidermis + Papillare	.05+	1.7 Epidermis + Corium	2.3	Dead 1 Layer	Dead 2 Layers	Live			
Lamp	Filters	λ										2	4	4	9	13	25
Infrared	No	1400+	45	45	42	30	25	15	13	9	7	—	—	6	3	1	0
Incandescent Bulb	7 mm. Water 88a	1000+	70	72	70	60	52	33	23	20	15	40	17	15	9	5	0
	15 mm. Water 23e	800+	77	77	70	65	60	37	32	25	19	50	28	25	10	8	1
KROMAYER	16 2	560	85	90	87	80	74	39	30	8	3	—	—	3	2	1	0
	75η	491	85	88	84	77	74	28	16	6	2	—	—	—	0	0	0
	36 2	420	80	85	81	70	50	10	7	3	1	—	—	—	—	—	—
	18a 2	385	80	80	75	62	46	6	1	t	0	—	—	—	—	—	—
	Uviol 18a	360	70	78	73	50	47	3	1	0	0	—	—	—	—	—	—
	18a 12	324	54	60	56	30	24	t	0	0	0	—	—	—	—	—	—
	Vapor Corning Lead Acetate	280	25	20	16	13	11	0	0	0	0	—	—	—	—	—	—
	2 Vapor Corning	267	20	18	15	9	6	0	0	0	0	—	—	—	—	—	—

t=trace

importance of distinction between true absorption and absorption due to scattering. True absorption represents actual transformation of light energy into chemical energy, with the result that the light cannot be recovered. By scattering, light is dissipated in all directions. Therefore, most of the light is missing after transmission through the scattering object in the direction of its original propagation, but it still exists as light and can be identified outside the direct beam of transmitted light. In immediate contact with the scattering substance, the loss of energy is small, but it increases rapidly with increasing distance from the scattering body. Both types of absorption are superimposed; and another investigation[2] was undertaken in order to disentangle the two components. For this work, the transmission through several specimens of human and rabbit ear skin was studied under three conditions.

1. The skin was brought in immediate contact with the photographic plate by use of a specially constructed plate holder with a large hole. The skin was placed on the opening of a short hard rubber tube, and this was slid into the hole of the plate holder and into closest contact. Filters transmitting narrow spectral ranges were put immediately in front of the skin. A shutter allowed exposure to the Kromayer lamp from one second to any time up to 2,000 seconds.

2. The skin was placed on the slit of the spectograph in immediate contact with the metal parts and the usual spectographic observations were made.

3. The skin was placed half way between the light source and the photographic plate, and the light was conducted through blackened stovepipes. A series of diaphragms prevented any light from going from the light source to the plate except on a straight line. The total distance amounted to approximately 12 feet.

With these arrangements, we were

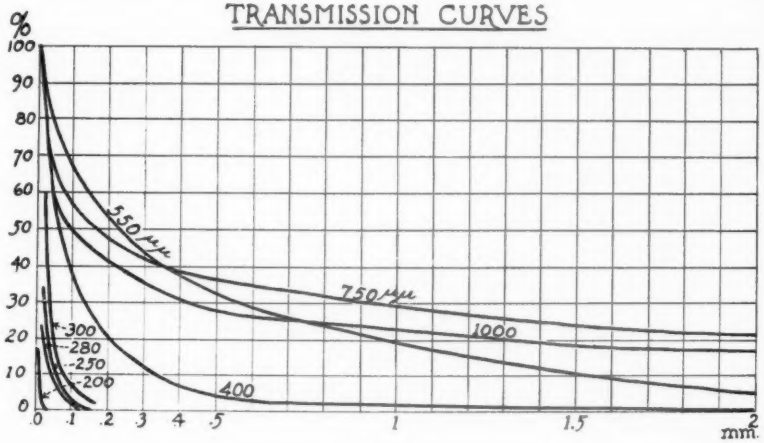

Figure 2.

2. Bachem, Albert, and Reed, C. I.: Arch. Phys. Ther., X-Ray & Rad., 11:49 (Feb.) 1930.

able to determine: 1. The light transmitted, including all the scattered light. This case comes very close to the actual conditions of irradiation of the skin. All the scattered light is registered. Even a back scattering might occur owing to the presence of the photographic layer, as may happen within the skin. With this method, one can determine the coefficient of true absorption. 2. The transmitted light, with all the scattered light excluded. This case is not immediately comparable to any actual therapeutic conditions. From the resulting figures, one can determine the total absorption coefficient.

The spectrographic method was tried in order to determine whether its results come closer to the conditions of true or total absorption, and how close the spectrographic observations correspond to the conditions of practical light exposure. As a result of this investigation, we found that the near ultraviolet and the actinic rays are more scattered than truly absorbed. True absorption increases so rapidly toward shorter wave lengths that, in the extreme ultraviolet, the ratio may be reversed. This investigation also shows that the spectrographic method is not suited for the quantitative study of the transmission of an object which scatters the radiation as much as does the skin.

Therefore, the final work[3] on the ultraviolet transmission of skin was done by a photographic method in which the rays of the Kromayer lamp were purified by a filter and rendered monochromatic by an ultraviolet monochromator. A special mechanism was designed for placing the photographic plate in immediate contact with the skin specimen after every shift. For the wave length 254 mμ, the cold quartz lamp was used with the mon-

LIGHT DISTRIBUTION IN THE SKIN

LAYER	λ / mm	200	250	280	300	400	550	750	1000	(1400)	μμ
		100	100	100	100	100	100	100	100	100	APPLIED
CORNEUM	.03	(100)	(81)	(85)	(66)	(20)	(13)	(22)	(29)	(36)	ABSORBED AND REFLECTED
		0	19	15	34	80	87	78	71	44	TRANSMITTED
+MALPIGHII	.05	(0)	(8)	(6)	(18)	(23)	(10)	(13)	(6)	(16)	ABSORBED
		0	11	9	16	57	77	65	65	28	TRANSMITTED
+CORIUM	.20	(0)	(11)	(9)	(16)	(56)	(72)	(44)	(48)	(20)	ABSORBED
		0	0	0	0	1	5	21	17	8	TRANSMITTED
+SUBCUTAN.	.25	(0)	(0)	(0)	(0)	(1)	(5)	(20)	(17)	(8)	ABSORBED
		0	0	0	0	0	0	1	0	0	TRANSMITTED

	EXTREME U-VIOL.	FAR ULTRA VIOLET	NEAR U-VIOL.	VISIBLE VIOL. GREEN RED	NEAR INFRA RED	FAR INF. RED
GENERAL REMARKS	All absorbed by corneum. No radiation reaching germinativum.	Greatest absorption in stratum corneum. Some radiation reaches corium (papillare). No radiation reaches subcutaneous layers.	Relatively large absorption in stratum Malpighii.	Minimum absorption in stratum corneum. Most radiation absorbed in corium. Pronounced radiation reaching subcutaneous layers.	Strongly increasing absorption in upper layers, decreasing in lower layers.	Practically no penetration.

Figure 3.

3. Bachem, Albert, and Reed, C. I.: Arch. Phys. Ther., X-Ray & Rad., 12:581 (Oct.) 1931.

ochromator only, for the reason that, in this lamp, nearly the total spectral energy is concentrated in the so-called resonance line $\lambda = 254 m\mu$.

Using this method on a large number of skin specimens, we determined the amount of light of different wave lengths that penetrates through the horny layer, through the whole epidermis and into different depths of the corium and the subcutaneous layers. The direct results of our measurements are given in Table 1.

These figures are plotted in Figure 1 as transmission curves for the corneum, the epidermis, the skin down to the papillary layer of the corium and one specimen with the whole corium included. The epidermis curve was taken from specimens in which the granulosum and part of the prickle-cell layer were blistered off. Because of the great transparency of this layer, the thin basal-cell layer would not have increased the absorption markedly.

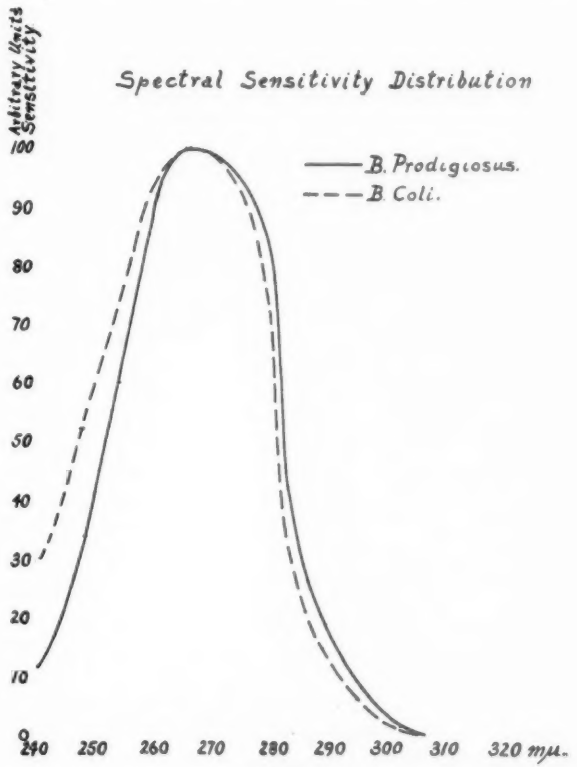

Figure 4.

Owing to the spectral width of the filter spectrums, the finer details in the far ultraviolet and the infrared were not registered. Therefore, the curves had to be corrected in the ultraviolet by compari-

son with the absorption curves obtained in former experiments by the use of the spectograph. The hemoglobin absorption at 400 and between 500 and 600 mμ is indicated in the curves, but probably not strongly enough, owing to the width of the filter spectrums, and the fact of our working with dead material taken from bodies and moistened by saline solution. While these finer details are less evident in these curves than in the ones obtained before with the spectrograph, the quantitative transmission is obtained with much greater accuracy by registering the scattered radiation by these experiments; which was greatly neglected in the spectrographic observations.

TABLE 2.—TRANSMISSION OF LIGHT

Wave Length	Material				Thickness Mm.
	Dentin	Enamel	Cement	Mucosa	
Infrared	96 %	97 %	98 %	97 %	0.01
	68	82	84	69	0.1
	2.3	15	18	2	1
Visible	95	97	98	97	0.01
	63	82	84	70	0.1
	1.2	16	18	2.3	1
Violet	96	96	97	97	0.01
	65	76	83	69	0.1
	1.6	8	17	2	1
365 mμ	94	94	96	95	0.01
	56	62	71	57	0.1
	0.4	4.3	3.5	0.4	1
334 mμ	93	94	95	94	0.01
	48	60	67	48	0.1
	0.1	4	2.7	0.1	1
313 mμ	93	94	94	94	0.01
	46	62	59	52	0.1
	0.1	2.4	0.6	0.2	1
302 mμ	91	92	92	92	0.01
	41	53	54	45	0.1
	0.0	1	0.4	0.0	1
280 mμ	85	90	89	78	0.01
	18	45	43	12	0.1
	0.0	0.3	0.4	0.0	1
265 mμ	83	90	88	75	0.01
	17	41	41	11	0.1
	0.0	0.1	0.1	0.0	1
254 mμ	79	88	88	60	0.01
	15	39	39	2	0.1
	0.0	0.0	0.1	0.0	1
248 mμ	79	89	87	69	0.01
	15	40	36	9	0.1
	0.0	0.0	0.0	0.0	1

These curves show clearly that the maximum transmission occurs for the corneum in the visible part of the spectrum, particularly in the yellow and green. This accounts for the great optical translu-

cency and the greenish yellow shade of the blister specimens. The maximum is more pronounced for the whole epidermis, with more absorption in the violet and red end, causing a brownish appearance of these layers. In the curves of the thicker layers, the maximum shifts more toward the red, and finally into the near infrared, because of the hemoglobin absorption in the visible spectrum.

From these curves, a set of transmission curves were obtained for the most important wave lengths. (Fig. 2.) These curves show the intensity decrease of the light with the increasing thickness of the tissue. The decrease is very pronounced in the ultraviolet, and much reduced in the visible and infrared, particularly in the lower parts of the corium. The greatest penetration is found for 550 mμ in the upper corium layers, and for 750 mμ in the lower parts of the skin.

From these observations, an effort was made to determine the distribution of the transmitted light and its absorption in the various parts of the skin. The results for the most important wave lengths between 200 to 1400 mμ are given in Figure 3.

The thickness of the horny layer was taken as 0.03 mm., the average from our observations on the flexor side of the arm and the abdominal skin. The average thickness of the whole epidermis was estimated as 0.05 mm.; 2 mm. was set for the epidermis and corium, and 25 mm. was considered as the thickness of the skin and subcutaneous layers, in which practically every trace of transmitted light disappears.

The applied light is arbitrarily set as 100 for each wave length. This makes our results applicable to any light source, provided the spectral intensity distribution is known. The simple figures in the horizontal lines between the various layers indicate the light transmitted through the layer above and entering the layer below. The light absorbed in the respective layers is given in encircled figures. It was figured as the difference between the light entering and that passing through the respective layers. A certain inaccuracy occurs for the upper layers, which reflect a small part of the light. This inaccuracy is indicated by the vertical arrows representing the light reflected by these layers. The actual absorption will be somewhat smaller in these layers. An estimate of the correct amount was not made. The results are discussed at the bottom of the chart. (Fig. 3.)

The following conclusions can be drawn from our results:

1. Visible (and near infrared) rays are strongly absorbed by the blood of the corium and subcutaneous layers. The heating effect must be rather mild because of the small absorption in the epidermis and the strong convection by the blood stream.

2. The far infrared have little penetrating power. Most of the light is absorbed in the epidermis. The produced heat is slowly conducted down to the deeper layers and up to the surface and convected away by the blood stream and air circulation. Overexposure of the germinal layer may lead directly to blistering.

3. The ultraviolet exhibits greater variations than the other parts of the spectrum. At 280 mμ, the absorption in the corneum (and granulosum) is very pronounced. The great antirachitic effect of this wave length must occur in or above these layers. At both sides of this wave length, at 300 and 250 mμ, the penetration is greater, more radiation reaching the malpighian layer and the corium. These observations, together with those of Hausser and Vahle, indicate that erythema production occurs in the germinal layer (or the corium) in the shadow of the upper layers. The stratum corneum

(plus granulosum) must play an important rôle in the protection of these sensitive layers against too strong irradiation.

From 250 mμ on, the absorption of the horny layer increases rapidly. Near 200 mμ, the absorption is so nearly complete as to prevent any radiation from reaching the living layers of the skin.

In collaboration with A. Gorodazky, I have applied the same method to the mucous membrane of the mouth of the dog in order to obtain figures which are of particular interest to dentistry. Human tooth material, such as sections through dentin, enamel and cementum, has also been studied.

Table 2 gives the results of these investigations. The chart depicts the percentage transmission figures for three selected thicknesses: 0.01, 0.1 and 1 mm., respectively. These figures were obtained by the use of the exponential absorption law, from the measured figures for the actual thickness of each specimen. In the case of homogeneous material, such as dentin, this method gives a good approximation. In the case of the mucous skin, which consists of several layers of varying transmission, we cannot expect any great accuracy.

From these figures, we conclude that the infrared and visible light penetrate deeply into the dental tissues. The transmission decreases strongly in the near ultraviolet and the actinic rays therefore exhibit a very weak penetration. The depth of 0.1 mm. is reached by less than 50 per cent of the incident rays, and only traces are found at a depth of 1 mm. Hence, we have to state that the dentin, the pulp and the root canal do not receive any appreciable amount of actinic energy. Practically all this energy is absorbed by the enamel, the gingiva and the cementum. It seems doubtful that the absorbed energy causes any biologic effect in these tissues, except the gingiva, where it causes erythema. It may be that enough actinic energy reaches the dentino-enamel junction to produce biologic effects.

One of the most observed and best studied reactions caused by ultraviolet irradiation is the erythema. In contrast to the heat hyperemia, the erythema reaction is produced by the chemical action of ultraviolet rays, which penetrate into the prickle-cell and basal-cell layers of the skin.

The erythema producing effect, as established by Hausser and Vahle and confirmed more recently by Luckiesh and Coblentz and their co-workers,[4] varies with the wave length of the applied ultraviolet. It is maximal at 300 and 250 mμ, which shows a pronounced minimum at 280 mμ.

This spectral distribution of the erythema-producing effect is in close agreement with our findings concerning the penetrating power of ultraviolet, which is sufficient in the areas of 300 and 250 mμ, but too weak at 280 and below 240 mμ; while above 300 mμ, the ultraviolet absorption of the proteins is not sufficient to cause any marked chemical effects. Hausser and Vahle established two important facts for the two sensitivity areas:

1. The latent period and the reaction time is much shorter for the 250 mμ area than for the one of longer wave length.

2. The range of the exposure time for producing an erythema without causing blistering is much greater for the short wave maximum than for the one of longer wave length.

Whether similar conditions hold true for the mucous membranes of the mouth has never been established and cannot be

4. Hausser, H. W., and Vahle, W.: Str. Ther., 13:41, 1921. Luckiesh, M.; Holladay, L. L., and Taylor, A. H.: J. Opt. Soc. America, 20:423, 1930. Coblentz, W. W.: Stair, R., and Hogue, J. M.: Str. Ther., 42:373, 1931.

deducted from the few transmission figures available at the present time.

The antirachitic effect of ultraviolet light and its spectral distribution have been studied extensively. Pappenheimer and Weinstock[5] and Hess and Weinstock[6] have shown that the antirachitic effect, if the skin is irradiated, starts from 313 mμ toward shorter wave lengths. Many observers assume a maximal antirachitic activity in the range of about 280 mμ, for the reason that ergosterol has three pronounced absorption bands in that spectral area. My own investigations proved that the antirachitic effect is still very pronounced at 254 mμ.[7] I exposed two rats, which were kept on a rickets-producing diet (Steenbock), to the cold quartz body lamp through a chlorine bromine vapor filter, which transmits about 50 per cent of $\lambda=254$ mμ, but absorbs everything above 280 mμ. The intensity of the transmitted ultraviolet rays (practically monochromatic 254 mμ) amounted to

$$25 \cdot 10^{-4} \frac{\text{Cal}}{\text{Cm}^2 \text{ min.}}$$

Five weeks' exposure for thirty minutes daily cured these animals, as could be demonstrated by roentgen-ray evidence. This experiment proves that ultraviolet of the wave lengths 254 mμ still has great antirachitic power. Nothing is known thus far about the short wave limit of the antirachitic effect, but it seems probable that the activation of the ergosterol takes place on the skin surface or in the most superficial layers of the skin, and that, therefore, rays of a very short wave length are able to participate in the activation.

Considering the bactericidal effects of ultraviolet rays, one has to distinguish between the bactericidal effect on the bacteria directly and the indirect bactericidal effects, due to the production of hyperemia or erythema.

The spectral distribution of the direct bactericidal effect of ultraviolet has been studied by many investigators, but no satisfactory quantitative figures have as yet been arrived at. Most authors agree that little bactericidal activity obtains above 300 or 313 mμ. Several authors claim maximal bactericidal activity at about 265 mμ. Others suggest increased activity with decreasing wave length. Bovie found great destructive effects in the range of Schumann rays ($\lambda< 200$ mμ).

Collaborating with M. A. Dushkin, I have studied the spectral distribution of the bactericidal effect by exposing agar plates seeded with *B. prodigiosus* and *B. coli* to the ultraviolet spectrum—obtained by the Kromayer lamp and a Hilger quartz spectrograph—the intensity distribution of which was carefully measured. Comparative figures over the whole spectrum could be obtained by exposing different parts of the same plate for different lengths of time; for instance, one, three, ten, thirty and 100 minutes. By control experiments, it was detected that the sensitivity of the bacteria toward irradiation changed markedly over such a long period of total exposure. In studying this feature, it was found that a maximum of sensitivity was reached several hours after the seeding of the bacterial plates. In the region of this maximum, the sensitivity was comparatively constant. Therefore, it was decided to make the exposures at the time of maximal sensitivity. Unfortunately, this time varied greatly, depending on the rate of growth of the bacteria, which, in turn, depended on the temperature at which the bacterial plates were kept before and during the

5. Pappenheimer, A. N., and Weinstock, M.: Proc. Soc. Exper. Biol. & Med., 20:14, 1922.

6. Hess, Alfred, and Weinstock, M.: J. A. M. A., 80:687 (March 10) 1923.

7. Bachem, Albert: Arch. Phys. Ther., X-Ray & Rad., 13:614 (Oct.) 1932.

exposure, and the density of the bacterial film and even the previous history of the bacterial culture. Therefore, all the factors had to be well standardized, in order to secure ultraviolet exposure at the time of maximal and uniform sensitivity. By determining areas of identical destruction, caused by exposure to spectral lines of different wave lengths, of different intensities and for different exposure times, the compartive bactericidal power of the various wave lengths could be quantitatively established. The results of this investigation for *B. prodigiosus* and *B. coli* are given in Figure 4.

The maximal sensitivity exists at about 265mμ. This sensitivity is arbitrarily set as 100. The curves drop sharply toward a longer wave length. From 313 mμ on, no bacterial sensitivity could be detected for our exposure times. The curves drop less abruptly toward shorter wave lengths. They may reach a minimum at about 248 or 240 mμ, which could not be determined properly owing to the lack of energy in the short wave part of the spectrum. These curves indicate again the great bactericidal power of the rays in the actinic area of the ultraviolet spectrum.

The indirect bactericidal effects are produced in the spectral area which causes erythema (at 250 and 300 mμ), and by the visible and infrared rays, provided enough radiation energy is applied to produce a heat hyperemia.

From this evidence, we should conclude that further investigation of the influence of ultraviolet irradiation on oral structures should be of interest. The efficient part of the spectrum ranges from about 220 to 310 mμ and coincides with the area of actinic rays. As far as therapy and prophylaxis are concerned, we have to distinguish between local and general applications of ultraviolet.

Two types of lamps are available for the local application of ultraviolet: the water-cooled quartz mercury arc, or so-called Kromayer lamp with quartz applicators, to direct the rays to the spot where they are wanted; and the orificial cold quartz lamp. In the case of the Kromayer lamp, the rays are produced outside the mouth, but directed into the mouth. Most of the radiation, although considerably weakened, is present at the end of the quartz rods. In the case of the cold quartz lamp, the rays are produced in the quartz tube, which is inserted in the mouth, and from which the rays emanate symmetrically and uniformly in all directions, except where deflected by protective covers.

For the general application of ultraviolet, a great many sources of light are available. The most important source of ultraviolet for the population at large is, of course, the natural sunshine. Its importance should not be underestimated, although its therapeutic usefulness varies because of its uncertainty. Among the controllable artificial sources of ultraviolet, the air-cooled quartz mercury and the cold quartz body lamp provide the proper range of ultraviolet light. The carbon arc is useful, if the core provides an abundance of actinic rays. While these lamps can be applied only under the supervision of a physician, dentist or trained nurse, the new S lamps of the General Electric Company, operating a mercury arc between two metal electrodes parallel to an incandescent spiral wire, are designed as a patient or family model for home use. These lamps provide a white light, very similar to sunlight, with an abundance, but no excess, of actinic rays. They can be used without danger of excessive dosage, provided the eyes are closed or kept out of the direct beam of light.

The Journal of the American Dental Association

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Editorials

THE NEED OF ENDOWMENTS IN DENTAL RESEARCH

On divers occasions the necessity has been urged for endowments to dentistry. Millions have been allotted to medicine, and justly so. Welfare work of all kinds has received generous and laudable support from individuals of means. Foundations have been formed for the express purpose of fostering enterprises tending toward the alleviation of human ills. Yet dentistry, aside from the beneficence of such enterprises as the Forsyth, Eastman, Carter, Samuels, Rosenwald and other donations of like character, has not for some reason attracted to it the support to which it is entitled.

We are deeply grateful for the establishment of the philanthropic agencies just enumerated and for the relief to children that has resulted therefrom. It is beneficence of a high order and worthy of all praise, but there is something more needed to meet the situation, something more fundamental and far reaching. What we most need is a liberal endowment in dental research that shall bring forth more

light on the cause of dental disease. Is it not strange that the most universal of all human ailments has not elicited from our philanthropists an endowment for the sole purpose of studying the manifestations of this disease? Why has not an attack been made on dental caries, the most prevalent of all diseases? Why has not an impression been made on some one of wealth to concentrate on this one disease and contribute the means for its study? Is it not passing strange that some one among the millions who have suffered the most poignant agony from toothache and the most disastrous results from dental infection has not so far chanced to be sufficiently moved with compassion to furnish funds for an endowment in dental research?

The profession has honestly tried to do its part. It has contributed from its own members a very respectable sum for research—not all, to be sure, for the study of dental caries, but for the study of various and sundry of our dental problems. The American Dental Association has devoted more than $350,000 of its funds to research, and this is no mean amount for the profession itself to contribute, to say nothing of various expenditures by individual dentists in furthering research. This at least has been a worthy gesture on our part, sufficient, it would seem, to entitle us to some consideration from individuals of wealth. Could funds be devoted to better purpose than this?

In an article on "Apes, Men and Teeth," by Prof. Earnest A. Hooton of Harvard University, in the January number of *The Scientific Monthly,* there is a rather pointed reference to the possible dire effects of bad teeth, and also to the fact that dental diseases are by no means confined to modern life. He says:

> However, the most shocking person in the array of fossil ancestors is the Rhodesian man, dug up in a zinc mine of South Central Africa and equipped with the most gorilla-like beetling bony brow-ridges, the longest face, the largest palate and the worst teeth of antiquity. Not only has this fellow reduced and degenerate wisdom teeth, but nearly all his teeth have been attacked by caries or decay; there were abscesses at the roots of many, and the "danger line" was riddled with pyorrhea—a septic condition of the gums which leads to eating away of the bony tooth sockets, loosening of the teeth, the entrance of all sorts of poisons into the system through the absorption of pus, to say nothing of "pink toothbrush." This Rhodesian man had an abscessed condition of the mastoid region which had drained right through the bone. In fact he sorely needed a dentist.

In answer to the question as to how to stop dental degeneration, Dr. Hooton says:

> In my opinion there is one and only one course of action which will check the increase of dental disease and degeneration which may ultimately cause the extinction of the human species. This is to elevate the dental profession to a plane upon which it can command the services of our best research minds to study the causes and seek for the cures of these dental evils.

May we not ask the learned professor if there is not a possibility that he has in this statement slightly put the cart before the horse? Is it not at least probable that if dentistry had been properly endowed as have other professions, our calling might conceivably have developed in unison with the opportunities thus presented? "No man ever died of too much encouragement," and it is not on record that a profession has languished in proportion to the amount of support which it has received from outside sources.

And let it be said with significant emphasis that whatever advancement has been made in the amelioration of human suffering from the teeth—an advancement the extent of which cannot be computed by the average lay mind—has been brought about solely through the agency and by the efforts of the dental profession itself. In saying this, we are far from assuming a vainglorious attitude, or priding ourselves on any unusual achievement. We are only too conscious of our limitations, and our sole contention is that we are more conversant with our problems than any other group can possibly be, and thus we court the assistance that is so sorely needed at this time.

It would be ungracious if we failed to express to Dr. Hooton our appreciation of his very sympathetic grasp of our dental educational necessities as a whole, as well as his valiant demand for adequate endowments. Every loyal member of the dental profession will second his appeal in this particular, and in doing so we may modestly claim to be unselfish in the matter. We are not asking aid for ourselves. The plea we make is on behalf of humanity at large, a humanity that is suffering today from a serious physical handicap that threatens to place a permanent embargo on the well-being of the people.

Why should this generation with all of its wealth of experience and material means permit the blight of dental disease to be passed

on to generations yet to come? Has not the record of the past given us sufficient incentive and sufficient vision to cope with a condition that no longer comports with what we have been pleased to term our modern civilization? Have we gone no farther than this? And must we stop where we are? Let our philanthropists answer.

Give us the means and we shall work as no profession has ever worked for the control of the ills that have so long beset us. We are frankly wearied with the mere amelioration of our dental troubles —our present outstanding ambition is, through the medium of research, to prevent them.

AN EFFECTIVE MEMBERSHIP DRIVE

In this issue will be found an article by Walter A. Wilson, of Jersey City, N. J., outlining a plan for increasing membership that we commend to the attention of every component society. The basis of success in this plan of the Hudson County Dental Society consisted in organization and hard work, and this is the basis on which the success of every membership drive must be built.

With all of the ulterior influences at work in the profession, the society realized that there must be a solid front of as nearly a 100 per cent membership of the licensed dentists of the community as possible, and the success of the drive may be imagined when it is known that the actual achievement was 95 per cent.

A study of the methods employed in this drive will be of interest to the officers and members of every component society. What has been accomplished in this society can be duplicated by every component if it sets itself to the task. If analyzed, this plan will be found to consist mostly of enthusiasm, tact, personal appeal and intense effort. As Dr. Wilson says, "We obtained success only in exchange for hard work."

To build up and maintain an active membership, one thing above everything else is important: first, the fundamental soundness of the principle of organization, which must appeal to every man who permits himself to consider the influences at work in our modern scheme of society; and the other is the closest personal contact be-

tween members and prospective members. Any aloofness is fatal to cohesion among the personnel of the membership. Dentists are human, and the personal touch is the vital spark that keeps alive their interest and their loyalty.

We congratulate the Hudson County Dental Society on its achievement, and we suggest that other communities take a chapter from their book, and thus solidify our membership from one end of the land to the other. Let's go!

A CERTAIN PHASE OF INSTRUCTION IN OUR DENTAL SCHOOLS

The enterprise known as dental education has many ramifications, it might be said many complications, the extent of which can be little realized by the rank and file of those who are not in any way connected with it. The preparation of dental students for the future practice of their profession involves much energy and application, to say nothing of a peculiar aptitude for pedagogy, and, above all, the necessary fundamental ethical approach.

Nothing means more in the problem of teaching dental students than the basic conception of professional ethics. It should form the groundwork of all of our teaching in a dental school, no matter what the department. The tendency toward a looseness in ethical concepts following the war makes it more difficult, but even more important, for the lines of ethical conduct to be more tightly drawn when it comes to the training of students in our dental schools, and nothing should be permitted to enter into the curriculum that will savor in any way of deception or evasion.

We have special reference here to a practice that has crept into some of our schools of permitting a student to have certain of the practical requirements performed by others instead of insisting that every bit of the work shall be done by the student himself. It is stated that, in some instances, the training in prosthetic dentistry is not so thorough as it should be owing to the plan of permitting a student to have certain of the technical procedures performed for him, this leading to the inevitable result that when the student

graduates, he is at the mercy of the dental technician or dental laboratory, because of the fact that he has never been taught how to carry a prosthetic case through from impression-taking to the final adjustment of the finished appliance in the mouth.

It is difficult to believe that any lapse of this character in the training of students is very pronounced or very general. At least we are convinced that the routine of prosthetic construction is taught to students, not only theoretically but also in a practical way, and that while the volume of practical instruction in this department is limited in certain institutions owing to lack of clinical material, we cannot imagine that students are deliberately turned out from any of our reputable institutions without the opportunity to acquire the necessary knowledge to enable them to construct prosthetic appliances in common with all other lines of practical instruction.

All we can say at this time is that if the charge herein indicated is true to any appreciable extent, or in any number of schools, it constitutes itself a real reflection on the integrity of our teaching bodies, and a very pertinent question is raised as to the ethical justification for such measures. To the extent that this is becoming a real abuse—which we find it difficult to believe—to that extent should it be reckoned with in no uncertain manner. We cannot afford in our present dental educational evolution to blink at facts, or to appear to condone in any manner the slightest semblance of ethical evasion, on the part of either our students or our instructors. The integrity of our teaching principles must not in any manner be jeopardized, for if there is one thing certain in dental education it is this, that the character of the profession of tomorrow will be largely governed by the impress that we make on the students of today.

THE BENEFICIAL CIRCLE PLAN

The circular letter, regarding the Beneficial Circle, sent out by the Secretary in December has brought out a hearty response on the part of the profession. More than 6,000 members have acknowl-

edged the appeal by returning the card and signifying their willingness to support the plan.

The idea emphasized is that by patronizing THE JOURNAL in the matter of advertising, the benefit to be gained may be represented by a circle as follows:

"More advertising in THE JOURNAL makes more funds available —permitting more educational work to be done—bringing more patients to the dentist—causing more materials and equipment to be used—creating more business for the dealer and manufacturer—permitting more advertising in THE JOURNAL."

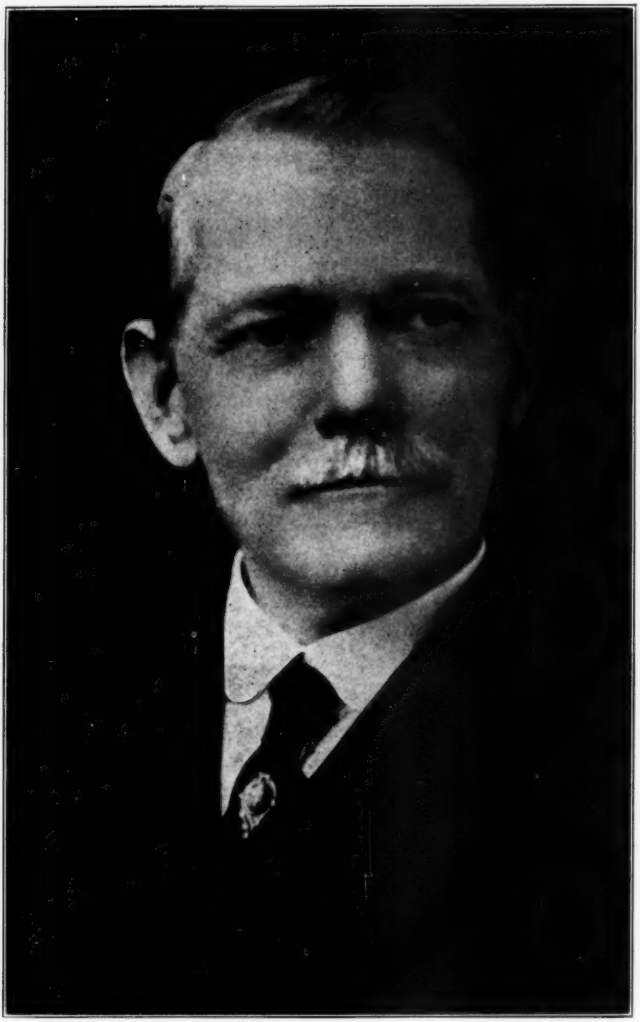
The benefits of this proposed increase in advertising are represented by added facilities for carrying on the work of the organization, and the inauguration of new enterprises whereby constructive service to the profession and the people may be greatly enhanced. All of our present working departments might thereby be immeasurably strengthened, and, as occasion arose, we could start new departments that have been under contemplation for some time, awaiting only the necessary funds.

The outlook for an increasing prosperity in the Association is very promising, and it is confidently hoped that the Beneficial Circle plan will prove an important agency in hastening this very desirable consummation.

If you have not already read the circular, please do so, and then govern yourself accordingly.

OUR CHILDREN

If we are to pass on to the generations of the future a proper heritage of health and happiness, we must begin now at the fountain source, and so guard our children against disease and deformity that they may be able to assume the responsibilities of life without the handicaps which too frequently have been the lot of humanity up to the present day. That is our problem, and it is a problem the solemn obligation of which cannot be ignored or shirked by any man or woman who has reached years of reasoning and responsibility.



ROBERT B. ADAIR, D.D.S.
(1849-1933)

Obituary

ROBERT B. ADAIR, D.D.S.

(1849-1933)

Robert Benjamin Adair was born in Jackson County, Georgia, May 27, 1849, and died after a lengthy illness at his home, 957 Virginia Ave., Atlanta, Ga., Dec. 26, 1933, in his eighty-sixth year.

Dr. Adair received his early education in the private schools of Jackson County, Georgia, and, after attending Martin Institute in Jefferson County for one year, entered the Baltimore College of Dental Surgery, in 1870, graduating from that institution in 1871. Soon after his graduation, he located in Gainesville, Ga., where he engaged in the general practice of dentistry. He was a great admirer of Dr. Riggs and his treatment of so-called "Riggs' disease." Throughout his professional life, he was interested in the treatment of pyorrhea. He removed from Gainesville to Atlanta in 1895 for the purpose of specializing in this field, at which time he gave to the profession his postoperative treatment of this disease.

Dr. Adair was pyorrhea clinician before the Medical Congress in Washington, D. C., in 1887. This was the first official recognition accorded dentistry by organized medicine.

He joined the Georgia Dental Society in 1872 and served as its president in 1891. He was for years a member of the Georgia Board of Dental Examiners. He served for many years on the Legislative Committee of the Georgia State Dental Society, and it was largely through his efforts that some of the first laws regulating the practice of dentistry in Georgia were enacted.

From time to time, Dr. Adair made valuable literary contributions to dentistry. His last work of this character was a most interesting treatise read before the Georgia State Dental Society, in 1926, and published in the October, 1926, issue of THE JOURNAL, under the title "Contributions Dentists Have Made Outside Their Profession."

Dr. Adair was deeply interested in promoting dental education. He was president of the Robin Adair School of Oral Hygiene. His contributions in aiding others in their struggle to procure an education were many but were known to but few.

He was a Christian gentleman and was one of the deacons in the First Baptist Church of Atlanta for more than thirty-five years.

He was first married in 1873. His wife died in 1907. He was married the second time in 1912 to Miss Mattie M. Simmes, of Raleigh, N. C. Dr. Robin Adair, his only son, born of his first marriage, was killed in an automobile accident in 1929.

The widow and four grandchildren survive.

S. W. FOSTER.

COUNCIL ON DENTAL THERAPEUTICS

ENDOCRINES AND TEETH*

By ISAAC SCHOUR, D.D.S., Ph.D., Chicago, Ill.

Requests have come to the Council for information on the relationship of the endocrines and the teeth. The Council therefore invited Dr. Schour, associate professor of histology of the College of Dentistry, University of Illinois, to review and critically evaluate the literature in this field. The Council endorses the conclusions in this report.

SAMUEL M. GORDON, *Secretary.*

A KNOWLEDGE of the endocrines and their dental aspects is of distinct value to the dentist. It is sometimes possible to arrive at an early diagnosis of an endocrine disturbance by recognition of early oral symptoms, as in acromegaly or in diabetes. The dentist can thus be of great service to the patient by indicating the need for immediate medical attention. In addition, the treatment of the oral symptoms will be more successful because of better knowledge of the cause and greater appreciation of the special care indicated in the particular dental operations.

Among the first references to a relationship between the endocrines and dental tissues are those of Marie[1] (1886), who described a characteristic enlargement of the mandible in acromegaly, and those of Erdheim[2] (1906), who found that dentin was imperfectly calcified in the absence of the parathyroids. The endocrines will be discussed in the following order: (1) gonads, (2) suprarenals, (3) islands of Langerhans, (4) thymus, (5) thyroid, (6) parathyroids and (7) hypophysis.

Since there is so little that has been definitely established concerning the pineal body, this organ will not be discussed in this paper.

GONADS

Removal of Testes.—Eunuchs have been the subject of a careful study by Tandler[3] (1909). Since practically all castration was done not soon after birth but at a time when the development of the teeth was practically completed, changes in the teeth have not been reported. Kranz[4] reports that in rats, castration results in production of teeth of small size, but in no histologic change. My experiments confirm this. Kranz also found that castrated male pigs have smaller canines than do boars.

*From the Department of Histology, College of Dentistry, University of Illinois.

1. Marie, P.: Sur deux cas d'acromegalie, hypertrophie singuliere noncongenitale des extremites superieures, inferieures et cephalique, Rev. Med., 6:297-333, 1886.

2. Erdheim, J.: Tetania parathyreopriva, Mitt. a. d. Grenzgeb., 16:632-744, 1906.

3. Tandler, J., and Gross, S.: Ueber den Einfluss der Kastration auf den Organismus, Arch. f. Entwicklngsmech. d. Organ., 27:35-61, 1909.

4. Kranz, P.: Innere Sekretion in Beziehung zur Kieferbildung und Zahnentwicklung, Deutsche Zahnheilk. in Vorträgen, 32, 1914.

Gonads and Caries.—Considerable literature has developed on the relationship between the gonads and caries. Biedl[5] interprets an increase of caries at puberty, and during pregnancy and lactation on the basis of gonadal influence. Convincing evidence that endocrine changes in pregnancy and other conditions cause caries of teeth has not been established. The popular saying "For every child, a tooth" has not been substantiated statistically (Schmidt,[6] 1930). A possible higher incidence of caries during pregnancy could be more logically associated with inadequate oral hygiene or local disturbances in the oral cavity.

Gonads and Periodontal Lesions.—The literature contains many statements that gingivitis and pyorrhea are associated with a disturbance in the gonads (Biedl,[5] 1931). Doppler, who studied the periodontal conditions in men with gonad disturbance, frequently found gum tissue recession and signs of alveolar atrophy. In 15 per cent, there was ready bleeding of the gum tissue. The chemical elimination of the sympathetic innervation system of the spermatic cord resulted in the cessation of pyorrheic conditions within from a few to eight weeks after the operation. Doppler explains this reaction on the basis that his operation results in an increased hormonal function of the gonads. In women, these changes are more frequent (Biedl,[5] 1931).

Ovaries and Gingivitis.—Gingival changes have been observed in women at puberty, during and just prior to menstruation and in pregnancy. Davis reported a case of a woman, aged 30, in whom stomatitis occurred during menstruation but disappeared after the removal of both diseased ovaries (cited by Schmidt,[6] 1930). Stoloff[7] (1933) has suggested the term periodic menogingivitis to designate the congestion and ready bleeding of the gum tissue observed particularly in association with gynecologic disturbances.

During pregnancy, there is a higher incidence of gingivitis. The latter is characterized by a hyperemic edematous swelling of the gum tissue of endocrine (ovarian) and vasomotor origin principally around the incisors and cuspids. Freund, Pinard and Schmidt[6] and Korkhaus[8] found gingivitis in from 53 to 60 per cent of pregnant women, while control studies in nonpregnant women of the same groups showed only 15 to 18 per cent incidence (Schmidt, 1930). The view that this type of gingivitis is of endocrine origin has been confirmed by Ziskin and Blackberg[9] (1933), who produced experimentally hyperplasia of gingival epithelium, resembling pregnancy gingivitis, by injecting monkeys with sex hormones.

Hypergenitalism.—Clinical reports indicate that hypergenitalism, as found in early puberty, induces an acceleration of eruption. White and Breschet reported a case of a boy who was sexually mature at the age of 2 years and who showed a complete deciduous dentition at the age of 1 and a change to the second dentition at the end of the third year. Hedman reported a case of a boy who was sexually mature at 4½

5. Biedl, A.: Zahnsystem und innere Sekretion, Korrespbl. Zahnärzte, 55:99, 1931.

6. Schmidt: Gravidität und Zahnfleischblutung und Kalkstoffwechsel, in Kantorowicz, Alfred: Handwörterb. d. ges. Zahnheilk., 1930.

7. Stoloff, C. I.: Periodic Transitory Menogingivitis Incidental in Women, J. D. Res., 13:190 (June) 1933.

8. Korkhaus, G.: Changes in Form of Jaws and in Position of Teeth Produced by Acromegaly, Internat. J. Orthodontia, 19:160-174 (Feb.) 1933.

9. Ziskin, D. E., and Blackberg, S. N.: Experimental Study of Gingivae During Pregnancy, J. D. Res., 13:253 (June) 1933.

years and whose permanent incisor had already taken the place of the deciduous one at the age of 3½ years.

SUPRARENALS

The effect of the suprarenals on the teeth is an unexplored subject. Pigmented spots and stripes are often observed in the oral mucosa and gum tissue in Addison's disease. According to Kranz[4] (1914) and Herbst[10] (1926), disturbed suprarenal function is frequently associated with loosening of teeth and alveolar pyorrhea. Falta[11] (1923) found accelerated dentition associated with a tumor of the suprarenal cortex. Wiesel[12] (1930) reports marked development of the dentition in suprarenal hyperfunction and retarded development in suprarenal hypofunction.

ISLANDS OF LANGERHANS

The association of pyorrhea with diabetes is generally accepted. As early as 1887, Magitot pointed out that loosening of teeth was an early oral symptom. The removal of the pancreas results in changes in the gums (Biedl,[5] 1931). In the diabetic patient, whose resistance against infection is considerably lowered, the gums, particularly the interproximal portions, are swollen and spongy and bleed easily. Pockets form and become suppurative. The periodontal tissues are predisposed to pyorrhea. Thus, it has been suggested that a blood analysis and urinalysis be made in all cases of loose, painful teeth with suppurating pockets (Misch, 1922). The teeth in some cases become firm after the cure of diabetes (Slauck,[13] 1930). According to Kranz[4] (1914) and Biedl[5] (1931), the loosening of teeth in diabetes is associated with the hyperglycemic condition. Although caries is not as a rule found in a pyorrheic mouth, greater frequency and rapid progress of caries are reported.

THYMUS

The data available on the function of the thymus and its effect on the teeth are conflicting and highly confusing. It is therefore difficult to evaluate the dental findings reported in the literature. In view of the fact that a recent authoritative review on the physiology of the thymus concludes that there is no evidence of a specific endocrine function of the thymus, it seems to be rather far fetched to speak of "thymodontia."

THE THYROID

The thyroid is of special interest because its endocrine effects on teeth have been readily recognized, not only in experimental animals but also in clinical conditions.

Thyroidectomy.—The effect of thyroidectomy on teeth and jaws has been studied in dogs (Biedl,[5] 1914), pigs (Kranz,[4] 1914) and rabbits (Kranz,[4] 1914). The results varied with the duration of the postoperative life and the species of the animals, but indicated a condition similar to that found in cretinism. The experimental animals showed a general retardation in growth, typical cretinoid skull formation, retarded eruption and smallness of the teeth. Most of the experimental animals presented structural defects in the enamel in the form of transverse furrows on the

10. Herbst: Ueber Endokrinodontia, Deutsche zahnärztl. Wchnschr., 29, No. 15, 1926.
11. Falta, W.: Endocrine Diseases, Philadelphia: P. Blakiston's Son & Co., 1923.
12. Wiesel, J.: Nebennieren in. Handb. d. norm. u. pathol. Physiol., 16: (Part 1) 553, 1930.
13. Slauck: Innere Sekretion, in Kantorowicz, Alfred: Handwörterb. d. ges. Zahnheilk., 1930.

surface (Kranz,[4] 1914). Todd and Wharton report, in the *American Journal of Anatomy,* late eruption but no malformation of teeth of thyroidectomized sheep.

Cretins.—Kranz[4] (1914) summarized the findings in cretins on the basis of clinical and anatomic observations as follows: (1) frequent tooth and jaw anomalies; (2) marked retardation of the dentition and an irregular position of the teeth; (3) very defective tooth structure; (4) a wide-spread incidence of caries.

Most of the findings of Kranz have been confirmed by other investigators. His findings of a greater than normal incidence of caries has been questioned by Biedl[5] (1931) and denied by Mayrhofer[14] (1914) and Schenkel[15] (1933).

Hyperthyroidism.—Hyperthyroidism in children results in an accelerated and orderly growth of the teeth. Biedl reports that in girls suffering from strumas of puberty, and especially in those with signs of a slight hyperthyroidism, he found a very regular dentition and teeth that were conspicuous for their excellent appearance. He found abnormal changes in the gingivae only in hyperthyroid conditions of long standing. The gingivae became intensely hyperemic and bled readily. Capillariscopic studies showed that these changes were due to a stretching and increase in capillaries.

THE PARATHYROIDS

Parathyroidectomy.—Erdheim[16] (1906) noted that from about six to eight weeks after parathyroidectomy, the rat incisors often fractured. On investigating this unexpected finding, he found that the dentin of the incisors was imperfectly calcified after the removal of the parathyroid, so that when the recently formed and therefore defectively calcified dentin moved forward and had to withstand the incisal stress in function, the dentin fractured.

Replacement Therapy in Parathyroidectomized Rats.—In 1911, Erdheim[16] reported successful replacement therapy in parathyroidectomized rats by means of autotransplants. He demonstrated that the dentin that was formed during the time that elapsed between the removal and vascularization of the transplant was well calcified. In the same report, Erdheim[16] emphasized the sensitivity of the dentin of the rat incisor to changes in calcium metabolism.

Tetany.—Erdheim's work in 1906,[2] to which I have referred, was really a study of tetany induced by parathyroid removal and was, therefore, entitled "Tetany Parathyropriva." Fleischmann[17] (1907-1909), who made comprehensive studies of the teeth of children that had tetany, found characteristic changes in the enamel, which showed hypoplasia, for the most part horizontally across the tooth in single or parallel rows or bands superposed one above another around the tooth. Fleischmann also showed that the teeth of adults who had tetany in their childhood presented similar typical enamel defects. Fleischmann therefore concluded that enamel hypoplasia was most characteristic for tetany and resulted from the underlying disturbances. It is of interest that the theory that enamel hypoplasia was associated with tetany was proposed by Magitot in 1879.

14. Mayrhofer, B.: Kretinismus und Gebiss, Erg. d. ges. Zahnheilk., 4:144-188, 1914.

15. Schenkel: Untersuchungen am Gebiss von Allgäuer Vollkretinin unter besonderer Berücksichtigung der Kariesfrage, Ztschr. Konstit. Lehre, 16:585, 1932.

16. Erdheim, J.: Ueber den Kalkgehalt des wachsenden Knochens und des Callus nach der Epithelkörperchenextirpation, Frankf. Ztschr. f. Pathol., 7:175, 1911.

17. Fleischmann, L.: Wien. klin. Wchnschr., 1908, p. 1761.

Hyperparathyroidism.—Little work has as yet been done on the problem of the effect of hyperparathyroidism on the dental tissues. Thoma[18] (1933), in three clinical cases of hyperparathyroidism characterized by generalized osteitis fibrosa and hypercalcemia, found, on microscopic study, no resorption of dentin.

Ham and I[19] (1934) reported on the effect on the dentin of the rat incisor of single injections of parathyroid hormone. We studied eight white rats that received one dose of 40 units of parathormone. This series included two rats that were killed at the beginning of the experiment. The remaining animals were killed at eighteen, sixty-six, ninety-four and 116 hour intervals after the administration of one dose. A blood calcium analysis was made of each animal at the time of death. The blood calcium was found to rise after the injection and to decline to normal in the animals that were killed later. The dentin formed during the rise of the serum calcium was poorly calcified. The dentin formed during the decline was well or excessively calcified.

Tweedy, McJunkin and I[20] (1934) studied the dental changes in twenty-nine rats that were given from one to fifteen injections of parathyroid hormone. The doses varied from 10 to 150 units. The experimental animals showed a primary hypocalcified stripe in the dentin that was being calcified during the immediate effect of the first injection and a secondary hypercalcified stripe in the dentin that was being calcified subsequently. The extent of the secondary stripe varied with the number and dose of the injections and the duration of the experiment. Enamel hypoplasia was found to be formed at the time of the first injection in five animals. The alveolar bone showed an abnormal increase in osteoclasts in fourteen and a fibrous change of the bone marrow in three of the animals that were given multiple injections of parathyroid hormone.

Caries and Calcium Metabolism.—The evidence available at the present time does not support the wide-spread supposition that the decay of teeth in pregnancy or other conditions is a result of calcium drain. Black and Türkheim[21] disproved that caries is associated with a disturbance in calcium metabolism and results from a lessened calcium content of the teeth. Furthermore, there is no evidence that the enamel is subject to calcium withdrawal (Schmidt,[6] 1930).

HYPOPHYSIS

Hypophysectomy.—Ascoli and Legnani[22] (1912), Aschner[23] (1912) and Downs[24] (1930) found that hypophysectomy in dogs resulted in delayed eruption of the teeth.

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18. Thoma, K. H.: Hyperparathyroidism: Effect on Tooth Development, J. D. Res., 13:250 (June) 1933.

19. Schour, Isaac, and Ham, A. W.: Action of Vitamin D and of Parathyroid Hormone on Calcium Metabolism as Interpreted by Studying Effect of Single Doses on Calcification of Dentin, Arch. Pathol., 17:22 (Jan.) 1934.

20. Schour, Isaac, Tweedy, W. R., and McJunkin, F. A.: Proc. Soc. Exper. Biol. & Med., 32, 1934.

21. Turkheim, H.: Kariesforschung, Fortschr. d. Zahnheilk., 9:359, 1933.

22. Ascoli, G., and Legnani, T.: Die Folgen der Extirpation der Hypophyse, München. med. Wchnscher., 59:518-521, 1912.

23. Aschner, B.: Ueber die Funktion der Hypophyse, Arch. f. d. ges. Physiol., 146:1-146, 1912.

24. Downs, W. G.: Experimental Study of Growth Effects of Anterior Lobe of Hypophysis on Teeth and Other Tissues and Organs, J. D. Res., 10:601-654 (Oct.) 1930.

Erausquin[25] (1917) found, in addition, shorter roots and wide pulp chambers and apical foramina. The histologic findings of these investigators were negative. Van Dyke and I[26] (1932) studied the dental changes in the hypophysectomized rats. Our findings in the rat incisor, which is a tooth of continuous growth, were: (1) retardation and final cessation of eruption; (2) smallness of the teeth (two thirds of the normal); (3) distortion of form, especially in the basal zone; (4) severe histopathologic changes.[27] In the molar, which is a tooth of limited growth and resembles the human tooth, the changes were: (1) retarded eruption; (2) decrease in size of the roots; (3) widening of pulp chambers and apical foramina; (4) histopathologic changes.[28] Van Dyke and I[29] also reported that the growth-promoting hormone, if not administered too late after the operation, increased the rate of eruption, which had become retarded immediately after the removal of the gland.

Hypopituitary Conditions in Man.—The dental changes in hypopituitary dwarfs are on the whole similar to those found in experimental hypopituitary animals. Eruption of the permanent teeth is retarded and the deciduous teeth persist. Enamel hypoplasia is frequent. The caries incidence is very small (Turkheim,[21] 1933). Biedl[5] (1931) observed, in many cases of hypophyseal infantilism (ateleiosis), a crumpled and senile face, which changed to one of normal appearance after treatment with anterior-lobe extracts. A hypopituitary case that is now being studied by Dr. Brodie and me shows retarded eruption and incomplete and retarded development of the roots of a number of teeth. The roentgenogram shows a thickening and increased calcification of the alveolar bone and lamina dura. The height of the bone from the root apices to the lower border of the mandible is abnormally low.

Hyperpituitarism.—In acromegaly, the spacing of the teeth is an early diagnostic sign. The prognathic mandible in the acromegalic has been regarded by some as a specific endocrine effect and by others (Korkhaus,[8] 1933) as a result of macroglossia.

CRITICAL COMMENTS

In evaluating the effect of endocrines on the teeth, one must guard against extremes. The view that the size and shape of the crowns of the teeth are diagnostic signs of endocrine disturbance is far fetched. Likewise, the view that endocrines have no effect on the teeth is equally incorrect.

Some reports speak of characteristic signs of the small or large size of particular teeth. I cannot accept the size or shape of certain teeth as diagnostic indicators of pituitary disturbance. The central incisors are reported to be larger than average in hypopituitary cases (Steuer,[30] 1929). One can readily recognize the fact that the central incisors appear to be and in fact are larger when compared to the smaller

25. Erausquin, R.: La hipofisis y el aparato dentario (presented at the Pan American Dental Congress at Chile, October, 1917).

26. Schour, Isaac, and van Dyke, H. B.: Effect of Replacement Therapy on Eruption of Incisor of Hypophysectomized Rat, Proc. Soc. Exper. Biol. & Med., 29:378-382 (Jan.) 1932; ibid., Effect of Hypophysectomy on Molar of Rat, 29:688-689 (March) 1932; Changes in Teeth Following Hypophysectomy. I. Changes in Incisor of the White Rat, Am. J. Anat., 50:397 (July) 1932.

27. Footnote 26, third reference.

28. Footnote 26, second reference.

29. Footnote 26, first reference.

30. Steuer, I. F.: Effects of True Infantilism on Jaws and Teeth, J. A. D. A., 16:1304 (July) 1929.

absolute size of the face and head. This does not prove that the absolute size of the incisors is significantly different from the average. The anatomic crown of a given tooth is of the same size regardless of its state of eruption. If a tooth is only partially erupted, that portion of it that is exposed to the oral cavity naturally is small. Neglect to distinguish between the anatomic and the clinical crown can thus readily lead to confusion and misinterpretation.

Unwarranted or exaggerated claims have been reported on the effect of the endocrines on the teeth as a result of misconception and insufficient appreciation of some elementary fundamentals about teeth. The two chief misconceptions are (1) that teeth are subject to change throughout life as are other tissues or organs; (2) that dental tissues undergo an early period of development, after which they do not change. The truth apparently rests between these two theories.

The first conception is incorrect because certain characteristics of the teeth, such as the shape and size of the crown, once determined by the enamel organ, are permanent and unchangeable except by trauma or surgery. Enamel once formed completely and calcified is not generally believed to become modifiable except by exogenous means.

The second conception is incorrect because the investing dental tissues, the gingivae, the periodontal membrane, the cementum and the alveolar bone can change readily even long after the tooth has come into occlusion. There is increasing evidence that dentin, too, may be subject to modification in the teeth of the adult.

ENDOCRINE THERAPY AND DENTISTRY

The employment of endocrine therapy in dentistry or orthodontia is scientifically unsound. It is reasonable to suppose that if, for instance, a given malocclusion is a result of an endocrine disturbance, the treatment indicated is one that will attack the original endocrine disorder. The solution of the latter lies in the realm of the internist and not of the orthodontist. If the internist is successful in curing the primary endocrine disturbance, the correction of the secondarily induced malocclusion may be facilitated automatically.

If a given patient presents symptoms in the face and oral cavity that are suggestive of an endocrine disturbance, the dentist or orthodontist has the opportunity and a responsibility to refer the patient to a competent internist for analysis and treatment. Any systemic treatment that may be indicated should be administered by the internist. If the systemic treatment is successful, the dentist may find that the tissue response of the patient will be more favorable and that his local correction of the dental disturbance will be more successful and permanent.

Endocrine therapy has great possibilities for good in certain definite instances; but it also has great possibilities for harm when wrongly used. It must be pointed out that our knowledge of the function of the various organs from which extracts are obtained is limited and for the most part at an experimental stage. It must also be pointed out that our knowledge of the possible influence of the endocrines on dental disturbances is very limited. It would therefore be doubly dangerous to use a potent substance in relative darkness. While further advance in endocrine knowledge may eventually prove to be of great value to dentistry, our present limited knowledge does not warrant endocrine therapy in dentistry.

ACCEPTED DENTAL REMEDIES

The following is a continuation of Accepted Dental Remedies. The Council will appreciate constructive criticism which will aid in future revision of the material.

SAMUEL M. GORDON, *Secretary.*

MAGNESIUM CARBONATE, U.S.P.—Magnesii carbonas (mag. carb.)—A mixture of hydrated magnesium carbonate and magnesium hydroxide corresponding to not less than 39.2 per cent of magnesium oxide (MgO).

Properties: Magnesium carbonate occurs as light, white friable masses, or a bulky white powder, without odor, and having a slightly earthy taste. It is practically insoluble in water and in alcohol, but soluble with effervescence in dilute acids.

Incompatibilities: It is incompatible with acids, with which it forms salts of magnesium.

Actions and Uses: Magnesium carbonate, when taken internally, neutralizes the acid in the stomach and is used in cases of hyperacidity of the stomach. It is mildly laxative owing to the action of magnesium. It has been suggested that magnesium oxide is preferable when the stomach should not be burdened with carbon dioxide gas, and hence is the best antidote against acids.

Magnesium carbonate is often used as a constituent of dentifrices, especially of tooth powders. It appears to aid the pouring of the powder. While it is used as an antacid for hyperacidity in the stomach, it does not appreciably affect the reaction of the saliva. It is not sufficiently absorbable from the oral mucosa or alimentary tract to produce the systemic effects of magnesium.

Dosage: As an antacid, 0.6 gm. (10 grains); laxative, 8 gm. (2 drams).

MAGNESIUM SULPHATE, U.S.P.—Magnesii sulphas (mag. sulph.) (Epsom salt) $MgSO_4.7H_2O$.

Properties: Magnesium sulphate occurs as small colorless, prismatic needles or rhombic prisms without odor, and having a cooling, saline and bitter taste. It is freely soluble in water (1:1.3), but practically insoluble in alcohol.

Actions and Uses: Magnesium sulphate is one of the most active of the saline cathartics, both the magnesium and the sulphate ions acting as osmotic cathartics. Much of the greater part remains unabsorbed in the intestines, where it retains fluid which liquefies the stools. If much of it is absorbed, it acts as a diuretic. The rate of absorption of magnesium sulphate from the alimentary canal is too slow to produce other systemic effects. A hypertonic solution is applied as a fomentation.

Dosage: 15 gm. (4 drams). Magnesium sulphate may be dissolved so that 2 c.c. of the solution contains 1 gm. of the salt, and, of this solution, 5 c.c. properly diluted is given hourly until evacuation is secured.

MERCURY AND MERCURIC COMPOUNDS

Compounds of mercury are primarily used in dentistry for their germicidal properties and for preparation of antiseptic and germicidal solutions for the sterilization of instruments.

Salts of mercury find their chief employment in therapeutics in the treatment of syphilis and other diseases of spirochetal activity. Compounds of mercury are also used for the preparation of antiseptic and germicidal solutions. The usefulness of mercury salts is limited by precipitation of proteinaceous matter, irritation and general toxic effects. As a result of these actions, much investigation has been carried on to obtain mercury compounds possessing the germicidal effects of simple mercuric inorganic salts, yet retaining the antiseptic activity.

The local effects of the mercury compounds are generally stated to depend on the concentration of mercuric ions in solution and on their precipitant effect on protein. The ionization is far from complete even in simple aqueous solutions, in which one of the most soluble salts, namely, mercuric chloride, behaves like nonelectrolytes (International Critical Tables, 4:256,

1928). The small amount which dissociates forms more $HgCl_4$ than Hg ions. (Krönig and Paul: *Biochem. Z.*, 145:131, 1903; Heubner: *Klin. Wchnschr.*, 10:1,999, 1931.) In body fluids, at times the ionization is even less. Here, protein complexes are formed. Mercury compounds have been classified into groups on the basis of their activity in restraining the fermentation of yeast. This classification has the merit of indicating the comparative precipitability for protein of different mercury products, whether ionized in the ordinary sense or reactive in some other way. (Peterson, J. B.: *J. A. M. A.*, 87:1926 [July 24] 1926.)

Class 1, the "simple ionizable" inorganic mercuric salts, precipitate proteins by redissolving in excess, and are more locally irritating than other mercury salts; rust metals; readily precipitated by hydrogen sulphide. To this group mercuric chloride belongs.

In Class 2, "moderately ionizable" mercuric compounds, protein precipitation is slight or absent. The irritation is relatively slight. Rusting of metals is slight and precipitated by hydrogen sulphide. Examples of this group are potassium iodomercuriate, mercuric succinimide and metaphen. All require alkali for solution.

In Class 3, "poorly ionizable" mercuric compounds, protein precipitation is absent; and irritation is very slight. They do not rust metals. Hydrogen sulphide precipitates mercury slowly. Examples of this class are mercuric oxycyanide, mercuric cyanide and mercuric benzoate.

Class 4 represents the mercuric fluoresceins of which mercurochrome is an important example. Mercury is firmly bound to the dye molecule.

Class 5 represents the insoluble mercurials which become active only by their conversion into soluble mercuric compounds. Examples in this group are mercury iodides, oxides and calomel.

Mercury finds its greatest use in dentistry as a local germicide and as a means for the sterilization of instruments. Because of the readiness with which mercuric chloride precipitates proteins and rusts metals and its general toxic effects, its use in therapeutics has been largely replaced by compounds of Classes 2, 3 and 4. The true usefulness of the newer mercuric compounds in dentistry has not yet been ascertained, although Corby (*D. Cosmos*, 62:612-619, 1920) advised mercuric cyanide in the treatment of Vincent's infection. Subsequent experience has not sufficiently confirmed the earlier reports. Metaphen appears to be widely used for cold sterilization of instruments.

The element mercury is used for amalgams.

MERCURY, U.S.P.—Quicksilver, Hydrargyrum (hydrarg.).

Properties: Metallic mercury in its ordinary form is a shining, silver-white volatile and fluid metal without odor or taste. In its massive form, it has comparatively little physiologic action and is not poisonous even in large quantities. When it has been reduced to a fine state of subdivision, it is capable of absorption either by the skin or by the mucous membrane, and it then produces the ordinary pharmacologic effects of its salts. It is also very active in the form of vapor.

Actions and Uses: Mercury compounds and metallic compounds are absorbed readily from all surfaces, even from intact skin. The excretion of mercury is chiefly in the urine and to a lesser extent in feces. Mercury has long been used as a component of filling materials. Stock (Z. Angew. *chem.* 39:461, 1926) has emphasized the harmful properties of mercury absorption from amalgam. This view is not generally shared by clinicians. The alloys of mercury used in dentistry are practically insoluble, hence, can do little harm. The application of quantitative chemical methods for the detection of extremely minute amounts of mercury which are now available may be applied to an investigation of the subject.

Aaron Isaacs has proposed the following specifications for mercury for dental uses based on work done at the Bureau of Standards (*J. A. D. A.*, 19:57 [Jan.] 1932):

1. The mercury shall have a bright mirror-like surface free from any film or scum. Under certain conditions of storage, mercury may develop a slight film. Such mercury should readily be separated from this film by filtration through chamois skin or some similar filtering medium, and when filtered should remain bright after agitation with air. It shall pour freely and in its entirety from a thoroughly clean glass container.

2. The mercury shall have a nonvolatile residue of not more than 0.02 per cent when the mercury is evaporated from a porcelain crucible at a temperature below its boiling point, and the crucible is then ignited at a dull red heat.

Mercury complying with the "tests for purity" of the U.S.P. X will meet these requirements.

MERCURIC CHLORIDE, U.S.P.—(Corrosive) (Bichloride of mercury, corrosive sublimate, mercuric chloride) $HgCl_2$. Hydrardyri chloridum corrosivum (hydrarg. chlor. corr.).

Properties: Corrosive mercuric chloride occurs in the form of heavy colorless crystals or a heavy white powder having an acrid and persistent metallic taste. It is permanent in the air. It is slowly soluble in water (1:3.8). Ammonium chloride, sodium chloride, tartaric acid and citric acid increase its solubility in water.

Incompatibilities: Corrosive mercuric chloride is precipitated from its solution by albumin, but redissolves in an excess of the albumin solution. Albumin in the form of egg white forms an antidote of limited value, as the mercuric albuminate formed is still toxic, and the antidote should be followed by evacuation of the stomach.

Corrosive mercuric chloride is incompatible with soluble carbonates and hydroxides, forming insoluble mercuric oxides; and, with small amounts of iodides, forming mercuric iodides or complex mercuric iodides. As a large excess of iodide dissolves these, prescriptions containing such combinations are permissible. It is incompatible with many alkaloids, and other organic compounds. It is reduced to calomel or metallic mercury by iron, zinc and other reducing agents. It dulls and tarnishes surgical instruments.

Actions and Uses: Corrosive mercuric chloride is used chiefly as a germicide and antiseptic. In the proportion of 1:20,000, it kills nonsporebearing bacteria and, in the proportion of 1:300,000, inhibits the growth of many forms. Spores of *Bacillus anthracis* are killed by a solution of 1:1,000. Its disinfectant action is limited by its deficient penetration and by the fact that it is greatly reduced by combination with organic matter. Corrosive mercuric chloride is irritant to the skin, causing dermatitis. A sufficient amount may be absorbed from the skin to produce serious poisoning. The effects of the poison when absorbed from the skin or mucous membranes are seen in ulcerative stomatitis and diarrhea, characterized by the passage of frequent foul-smelling and bloody stools resembling those of dysentery, various nervous symptoms, marked weakness and irritation of the kidneys with albumin and casts in the urine, leading to anuria. When taken in poisonous doses by mouth, it produces in addition irritation and ulceration of the mouth and throat, vomiting and corrosion of the mucosa of the stomach and intestines.

Its use as a mouth wash, while efficient, should be cautiously recommended because of its action on the superficial epithelial cells of the mucous lining of the mouth.

It is claimed to be useful as a disinfectant for putrescent root canals, and for abscesses and fistulas; and for sterilizing infected dentin, a 1:500 solution has been said to yield useful results.

Dosage: As an "antiseptic" solution, a concentration of 1:1,000 is used. The objectionable taste may be eliminated by suitable correctives.

MERCURIC CYANIDE—Hydrargyri cyanidum—Hydrargyrum cyanatum—$Hg(CN)_2$.—The mercuric salt of hydrocyanic acid.

Actions and Uses: Mercuric cyanide has been reported to be as actively antiseptic as mercuric chloride and to be less irritating; but this has been questioned. It is used locally and internally like mercuric chloride. Corby (*D. Cosmos*, 62:612, 1920) has suggested its use in Vincent's infection, but the advisability of this requires further confirmation.

Dosage: For topical applications to ulcerated areas, a 1 per cent aqueous solution is used.

Mercuric cyanide occurs in colorless or white prismatic crystals, or white powder, odorless and having a bitter metallic taste (the salt is exceedingly poisonous). It is darkened on exposure to light; is soluble at 15 C. in 12.8 parts of water and in 15 parts of alcohol; in 3 parts of boiling water and in 6 parts of boiling alcohol, and is very slightly soluble in ether.

Mercuric Cyanide—Mallinckrodt: A brand of mercuric cyanide, N.N.R.
Manufactured by Mallinckrodt Chemical Works, St. Louis. No U. S. patent or trademark.

Mercury Cyanide—Merck: A brand of mercuric cyanide, N.N.R.
Merck & Co., Inc., Rahway, N. J., manufacturer. No U. S. patent or trademark.

MERTHIOLATE, N.N.R.—Sodium ethylmercuri thiosalicylate. $C_2H_5HgSC_6H_4COONa$. Merthiolate contains from 49.15 to 49.65 per cent of mercury in organic combination.

Actions and Uses: Merthiolate, Lilly, is a potent germicide for sporebearing and nonsporebearing bacteria. It is used for sterilizing tissue surfaces. It does not precipitate with serum proteins. Merthiolate is much less toxic than mercuric chloride. Rabbits tolerated intravenous doses of 0.020 to 0.025 gm. per kilogram, and rats as much as 0.045 gm. when injected slowly,

the animals being observed in both cases for seven days. Hemolytic tests with washed red blood cells of rabbits indicate that merthiolate has relatively low hemolytic activity.

Dosage: The concentration recommended for general application is 1:1,000 isotonic solution. For hypersensitive mucous membranes, dilutions of from 1:2,000 to 1:5,000 may be used.

Manufactured by Eli Lilly and Company, Indianapolis, Ind. U. S. patent 1,672,615 (June 5, 1928; expires 1945). U. S. trademark 252,182.

Merthiolate Solution 1:1,000: One gram of merthiolate in 1,000 c.c. of water, buffered with 1.4 gm. of sodium borate in 1,000 c.c. and containing sodium chloride to make the solution approximately isotonic.

Merthiolate occurs as a cream colored nonhygroscopic crystalline powder, having a slight odor. It is stable in air, but unstable in any sunlight. One part by weight of merthiolate dissolves in approximately 1 part of water or in approximately 8 parts of 95 per cent alcohol. It is practically insoluble in ether and benzene. A 1 per cent solution in water has a p_H value of about 6.7. A 1 per cent solution is compatible with solutions of procaine and ephedrine salts.

This does not appear to be widely used, but may be tried for spot sterilization.

METAPHEN—The anhydride of 4, nitro-5-hydroxy-mercuri-ortho cresol. When metaphen is dissolved in alkali solution, the anhydride ring opens, forming the resulting sodium derivative. Metaphen contains from 56 to 57 per cent of mercury in organic combination.

Actions and Uses: Metaphen is a germicide, said to be more powerful than mercuric chloride and certain organic mercury compounds when tested on cultures of *Staphylococcus aureus* and *Bacillus typhosus*. (Birkhaug: *J. A. M. A.*, 95:917 [Sept. 27] 1930.) It is stated to be relatively nonirritating when applied to mucous membranes or the skin and to be without deleterious action on metallic instruments or rubber. Metaphen is said to be relatively nontoxic. White rats were found to tolerate doses of 0.004 gm. per kilogram when injected intravenously and to tolerate doses of 0.03 gm. per kilogram when injected intramuscularly. It is claimed that, in a solution of glycerine and propyl alcohol, it does not corrode metals. A solution of arsphenamine in metaphen has been suggested for Vincent's infection, but no evidence as to its advantage over a glycerine solution is available. A solution in an aqueous-alcohol-acetone medium is proposed for efficient skin sterilization, but these results remain to be confirmed for preoperative sterilization in the dental area.

Dosage: As a general mouth rinse, a 1:5,000 solution may be used. For use in Vincent's infection, a 1:1,000 solution is claimed to be useful. For sterilization of instruments, a 1:1,000 solution is used.

Manufactured by the Abbott Laboratories, North Chicago, Ill. U. S. patent 1,554,293 (Sept. 22, 1925; expires 1942). U. S. trademark applied for.

Metaphen 2,500: 1 part of metaphen dissolved in 2,500 parts of water containing 0.33 per cent each of sodium bicarbonate and sodium carbonate.

Metaphen Solution 1:500: 1 part metaphen dissolved in 500 parts of water by means of sodium hydroxide (four molecules of NaOH for every molecule of metaphen). The solution also contains 1 per cent of $Na_2CO_3.H_2O$.

Tincture of Metaphen 1:200: Metaphen 0.5 gm. dissolved in a liquid composed of acetone 10 c.c., water 40 c.c. and alcohol 50 c.c.

Metaphen is a yellow odorless and tasteless substance; insoluble in water, almost insoluble in methyl alcohol, acetone, ether and aqueous sodium carbonate, and sodium bicarbonate solution; soluble in dilute aqueous sodium hydroxide solution and in ammonium hydroxide solution; soluble in boiling glacial acetic acid and in nitric acid at room temperature.

POTASSIUM IODOMERCURIATE.—Potassii hydrargyri iodidum. A complex salt, K_2HgI_4, formed by the interaction of one molecule of mercuric iodide with two molecules of potassium iodide and containing about 25.5 per cent of mercury, in which the mercury is bound to iodine as an anion. It differs physically and chemically in several respects from mercuric iodide (cationic mercury).

Actions and Uses: Potassium iodomercuriate is used for the same purposes as mercuric iodide, over which it has some advantages because of its solubility. As a germicide it is effective as it does not coagulate albumin. There seems to be no work to show the usefulness of potassium iodomercuriate in the treatment of diseases of the oral cavity. In comparison with mercuric chloride, it is claimed that it has a greater safety factor. On the basis of animal experiments, it is about one-half as toxic as mercuric chloride weight for weight; but on the basis of the mercury content, it appears to possess about the same toxicity as mercuric chloride. In equivalent

concentrations of mercury ions, potassium iodomercuriate possesses one-one hundredth the toxicity of mercuric iodide for the flagellate dunaliella (Baas-Becking: Contributions to Marine Biology, Stanford University Press, 1930, p. 102).

Externally, potassium iodomercuriate is used for skin disinfection, irrigation and disinfection of instruments. In dentistry, its greatest usefulness may be found in the cold sterilization of instruments.

Dosage: As a germicide, it is used in the concentration of 1:100 to 1:10,000.

Germicidal Discs of Potassio-Mercuric Iodide, large.—P. D. & Co.: Disk-shaped tablets of potassium iodomercuriate containing an excess of potassium iodide, colored blue. Each disc represents mercuric iodide, 0.0971 gm. (1½ grains); potassium iodide, 0.0971 (1½ grains); sodium bicarbonate, 2.9259 gm. (45 grains).

Prepared by Parke, Davis and Company, Detroit, Mich. No U. S. patent or trademark.

Germicidal Discs of Potassio-Mercuric Iodide—P. D. & Co.: Disk-shaped tablets of potassium iodomercuriate containing an excess of potassium iodide, colored blue. Each disk represents mercuric iodide, 0.0283 gm. (⅜ grain); potassium iodide, 0.029 gm. (⅜ grain); sodium bicarbonate, 1.0368 gm. (16 grains).

Prepared by Parke, Davis and Company, Detroit, Mich. No U. S. patent or trademark.

MORPHINE SULPHATE, U.S.P.—Morphinae sulphas (morph. sulph.)—The sulphate of the alkaloid morphine.

Properties: Morphine sulphate occurs as white, feathery crystals of cubical masses, odorless, permanent in the air and having a bitter taste. It is soluble in water (1:15.5), but only slightly soluble in alcohol (1:565).

Incompatibilities: Solutions of salts of morphine are incompatible with alkalis, tannic acid, iodides and other precipitants of alkaloids.

Actions and Uses: Salts of morphine are used to a limited extent in dental surgery to lessen pain, to induce sleep and to facilitate anesthesia.

Morphine surpasses in efficiency all other analgesics, particularly for persistent pain and is used to dull rather than to abolish sensibility. The preferable route for administration is by injection of 5 to 15 mg. (¼-¼ grain) repeated as necessary. Atropine (which see) is given with morphine for hypodermic injections in order to diminish the effect of the latter on respiration. It acts as an efficient synergistic to other substances which produce anesthesia, since in safe doses it does not induce complete insensibility. Habituation to morphine is readily established. Hence, it may be stated in general that morphine should be used for the relief of pain only when satisfactory relief cannot be obtained by other methods. The barbiturates for inducing sleep and the salicylates, the phenetidines or the antipyrine compounds can be effectively and judiciously substituted to lessen pain.

Morphine causes a specific central analgesic action; a depressant effect on the respiratory center; a stimulation of the vomiting center followed by depression; a descending depressant action, preceded by stimulation, on the entire central nervous system, and a constipating effect resulting from a combination of central and local actions. It has no action on sensory nerves.

The systemic actions of morphine are greatly dependent on the doses used. The smallest doses producing therapeutic effects result in the relief of pain; somewhat larger doses cause definite cerebral depression leading to more or less profound and prolonged sleep. It does not endanger life through cardiac action. It is used in the treatment of persistent and troublesome cough, but has been largely displaced by codeine.

Morphine should not be used for the relief of pain in persons of a neurotic or hysteric temperament, unless its use is absolutely necessary. Prescriptions or orders for morphine must conform to the provisions of the Harrison Narcotic Act (see Cocaine).

Dosage: 0.008 gm. (⅛ grain). Smaller doses from 0.005 to 0.006 gm. ($\frac{1}{12}$ to $\frac{1}{10}$ grain), are often sufficient.

MYRRH, U.S.P.—(Gum myrrh) Myrrha (myrrh.)—A gum resin obtained from one or more species of commiphora.

Actions and Uses: Myrrh, like all other balsams, is used in medicine for local application as an antiseptic, an irritant and for "stimulating repair." It is used in the form of its tinctures, but its use is practically obsolete. It is a component of many nostrum preparations for conditions passing under the name "pyorrhea."

Tincture of Myrrh, U.S.P.—Tinctura Myrrhae (Tr. Myrrh.). One hundred cubic centimeters represents 20 gm. of the drug in about 86 c.c. of alcohol.

OXYQUINOLINE SULPHATE, NONOFFICIAL.—$(C_9H_7ON)H_2SO_4$. — A normal oxyquinoline sulphate.

Actions and Uses: So far as experimental evidence and experience go, oxyquinoline sulphate is nontoxic. It is a powerful antiseptic in vitro, somewhat stronger in this respect than mercuric chloride, and considerably stronger than phenol. It has been found to exert an antiseptic action in 1:10,000 solution. It is a feeble germicide, being weaker than phenol and much weaker than mercuric chloride. It is incompatible with alkaline substances (soap) and with salts of mercury and iron. Oxyquinoline sulphate does not coagulate albumin or injure the mucous membrane or tissues. The sensitiveness of patients to its solution varies considerably. In some, it produces a pronounced stinging when applied to mucous membranes even in dilute solutions (1:2,000) but it is claimed not to cause harmful irritation in any strength. The 1:1,000 solution has no analgesic action, while in 5 per cent powder form such action is present. Oxyquinoline sulphate is claimed to be an efficient deodorant. Oxyquinoline sulphate has been sold under a number of proprietary names, but it was originally introduced as "chinosol." Prolonged use in the mouth slightly darkens the teeth.

Dosage: As an antiseptic, the average strength of solution used is 1:1,000; as a nasal spray or douche, 1:3,000; as a gargle, 1:2,000, gradually increased in each case according to the tolerance of the patient up to 1:500. In gargles, the strength may be increased to 1:250. It has been used as a mouth wash in strengths of 1:1,000 to 1:100, flavored with an essential oil.

Oxyquinoline Sulphate—Merck: A brand of oxyquinoline sulphate, A.D.R.
Merck & Co., Inc., Rahway, N. J., manufacturer.

Oxyquinoline Sulphate—Seydel: A brand of oxyquinoline sulphate, A.D.R.
Seydel Chemical Co., Jersey City, N. J., manufacturer.

Oxyquinolin sulphate is a yellow crystalline powder of saffron-like odor and burning taste. It melts at from 175 to 177.5 C. It dissolves readily in water, but with difficulty in alcohol, and it is insoluble in ether. The aqueous solution has an acid reaction.

Peroxides and Per Acids

Hydrogen peroxide (H_2O_2) is a combination of two atoms of hydrogen with two atoms of oxygen, one of the latter being given off to oxidizable substances, leaving a residue of water. In the presence of catalase, a ferment found in all cells, it is readily decomposed. The liberated oxygen sometimes causes considerable effervescence. For this reason, it is dangerous to inject peroxides into closed body cavities or into abscesses from which the gas has not a free exit. Hydrogen peroxide solution (liquor hydrogenii dioxidi) is official in the U. S. Pharmacopeia. This preparation is a germicide when diluted with not more than twice its volume of water. Diluted with an equal volume of water, it destroys typhoid bacilli in two and one-half minutes. When freshly prepared, it destroys organisms commonly found in the oral cavity.

HYDROGEN PEROXIDE.—Hydrogen peroxide, absolute, is not commercially available. It is available in a 30 per cent solution, from which less concentrated solutions are made by dilution.

Hydrogen peroxide, 30 per cent, is free from acid, but more dilute solutions deteriorate unless preserved by some agent.

Actions and Uses: By suitable dilution, a preparation is obtained equivalent to the official solution of hydrogen dioxide. This is said to be more advantageous because of the absence of acid. The full strength preparation is caustic. In contact with pus, it is decomposed and the bubbling serves mechanically to cleanse a wound. A 25 per cent solution in ether has been used for the bleaching of the teeth and also as a caustic. The soft tissues of the mouth should be protected against the caustic action.

Hydrogen peroxide (H_2O_2 30 per cent) is dangerous to store and to handle. It may explode spontaneously. For bleaching teeth, it is frequently satisfactory. The crown of the tooth is cleansed, and the pulp canal sterilized and filled. With the *single* tooth under the dam, moisten a small bit of asbestos fiber with hydrogen peroxide, 30 per cent, then select a second bit of asbestos fiber and mix a sufficient amount of crown and bridge cement. As quickly as possible, place in the cavity the first bit of fiber, moistened with hydrogen peroxide, 25 per cent in ether; follow it at once with the dry fiber, and then the cement. Repeat treatment daily till the tooth

has been bleached several shades lighter than necessary. Later the tooth will darken slightly, but the exact degree of bleach is exceedingly difficult to obtain in the first instance, and to maintain.

Superoxol: A brand of hydrogen peroxide, 30 per cent.
Manufactured by Merck & Co., Rahway, N. J. No U. S. patent or trademark

HYDROGEN DIOXIDE, U.S.P.—Hydrogenii dioxidum.

SOLUTION OF HYDROGEN DIOXIDE, U.S.P.—Liquor hydrogenii dioxidi (liq. hydrog. diox.). Solution of hydrogen dioxide, U.S.P. (Solution of hydrogen peroxide).—A slightly acid aqueous solution of H_2O_2 (approximately 3 per cent) corresponding to about 10 volumes of available oxygen.

Properties: Solution of hydrogen dioxide is a colorless odorless liquid, having a slightly acidulous taste and producing a peculiar sensation and thick froth in the mouth. It is prone to deteriorate on keeping.

Actions and Uses: Hydrogen dioxide kills bacteria in cultures because of its oxidizing power. In contact with tissues, its germicidal power is very limited, owing to the fact that organic matter decomposes it. It is of value chiefly as a cleansing agent for suppurating wounds and inflamed mucous membranes. It is especially useful for this purpose because of the development of gas, which tends to loosen adherent deposits.

Dosage: Solution of hydrogen dioxide is usually applied diluted with from 1 to 4 volumes of water. It should be used with care in deep cavities. A free opening for the escape of foam and gas should be provided. This preparation may be used in the cleansing and treatment of infected pulp canals. Transfer a few drops to a dappen glass and force the solution slowly into the canal by means of paper pulp canal points or with brooches. Ulcerated areas in soft tissues respond favorably to the preparation also.

It is also used as a mouth wash, diluted with an equal volume of water.

METALLIC PEROXIDES

Metallic peroxides are compounds in which the hydrogen of hydrogen peroxide has been replaced by metals. They are readily decomposed with liberation of hydrogen peroxide or of oxygen.

Actions and Uses: Like hydrogen peroxide, the metallic peroxides depend for their value on the readiness with which a part of their oxygen becomes active. In the presence of moisture, sodium hydroxide is also formed as $2Na_2O_2+2H_2O\rightarrow 2NaOH+H_2O+O$. They are said to possess advantages over solution of hydrogen peroxide, because the oxygen is set free more gradually. The various metallic peroxides differ in their action in accordance with their solubility and the alkalinity produced by interaction of the peroxide with water. The action of peroxides is also affected by the nature of the metal which goes into solution when the peroxide is decomposed. Thus, the use of sodium peroxide is limited by the strong base formed when it dissolves in water.

The peroxides may also be used for the purpose of bleaching teeth and for putrescent root canals. In the case of sodium peroxide, the smallest possible particle is transferred by a brooch to the orifice of the pulp canal. The moisture in the canal will decompose gradually (but sometimes with explosive violence), the peroxide thus liberating oxygen and forming sodium hydroxide. The danger of this treatment lies in the possibility of some of the material's being carried beyond the apex of the tooth, into the periapical tissues, where it produces at once intense pain, and other symptoms of inflammation.

Because of the strong oxidizing effects on the lower organisms, the peroxides have been recommended as a convenient means of sterilizing water. Metallic peroxides (usually sodium) are used in concentrated solution for the bleaching of discolored teeth.

CALCIUM PEROXIDE, N.N.R.—Calcii peroxidum.—A mixture consisting essentially of calcium peroxide and calcium hydroxide and carbonate, containing not less than 60 per cent calcium peroxide, equivalent to 13.3 per cent available oxygen.

Actions and Uses: See preceding article on peroxides.

Dosage: For the bleaching of teeth, it may be used in concentrated aqueous solution.

Calcium peroxide is a light, cream-colored, odorless and tasteless powder. It is practically insoluble in water, but, by such contact, it is gradually decomposed into hydrogen peroxide and calcium hydroxide, the hydrogen peroxide being further decomposed by the alkaline calcium

hydroxide with liberation of oxygen. It is decomposed by dilute acids with formation of a solution containing hydrogen peroxide.

Calcium Peroxide—Merck: A brand of calcium peroxide, N.N.R.
Merck & Co., Inc., Rahway, N. J., distributor.

SODIUM PEROXIDE.—Sodii peroxidum. The sodium salt of hydrogen peroxide containing at least 90 per cent of sodium peroxide, Na_2O_2, equivalent to 18.4 per cent of available oxygen.

Properties: Sodium peroxide occurs in the form of a white, or yellowish, amorphous powder. It is soluble in water, with decomposition and evolution of heat, forming an alkaline solution and liberating oxygen. It dissolves in cold dilute acids, forming a solution of hydrogen peroxide. When heated, sodium peroxide becomes darker, but, on cooling, it resumes its original color. It does not react with alcohol, but it ignites ether on contact. A mixture with red phosphorus explodes under pressure on being struck. It is an extremely powerful oxidizing agent.

Actions and Uses: See metallic peroxides.

The solid substance has been recommended for the treatment of gangrenous pulps, but care must be used to prevent the material's being carried into the periapical tissues. In place of this, a solution of sodium hydroxide (50 per cent) has gained favor. The reaction of the sodium peroxide with the moisture of the canal results in the formation of the sodium hydroxide and oxygen, but it may happen that a particle of the undecomposed dioxide may be forced beyond the apex, where it produces intense pain.

It is used in concentrated solution for the bleaching of discolored teeth.

Dosage: See Metallic Peroxides.

Tests of Identity and Purity appear in New and Nonofficial Remedies, 1933, p. 323.

Sodium Peroxide—Merck: A brand of sodium peroxide, containing not less than 96 per cent of sodium peroxide.
Merck & Co., Inc., Rahway, N. J., distributor.

SODIUM PERBORATE, N.F.V.—Sodii perboras—Sodium perborate $NaBO_3 4H_2O$ is the sodium salt of the hypothetical acid—perboric acid. It should yield not less than 9 per cent of available oxygen.

Sodium perborate occurs as a white, granular or powdered salt, odorless and soluble in water; the solution has a saline taste. It is decomposed by water into hydrogen peroxide and sodium metaborate, $NaBO_3 + H_2O = H_2O_2 + NaBO_2$, producing an alkaline solution. It is decomposed by catalyzers, ferments and animal tissues. Heated to 60 C. (140 F.), it evolves oxygen, and when heated to a higher temperature, it gradually loses all its available oxygen and water of crystallization.

Action and Uses: Sodium perborate is an antiseptic deodorant, and bactericide and is used in wounds, purulent sores, etc. It is used extensively in cases of Vincent's infection because of its *supposed* property of liberating oxygen when in contact with mouth tissues, and is an ingredient of many tooth powders. It has been observed that sodium perborate does not liberate all the available oxygen at the reaction of the mouth fluids. In general, it is used in place of hydrogen peroxide, over which it has the advantage of yielding an alkaline solution. It is applied in substance or in solution. Three grams dissolved in enough water to make 100 c.c. yields a solution containing 2 volumes of oxygen.

Sodium Perborate, Flavored, Merck.
Manufactured by Merck & Co., Inc., New York City, No U. S. patents or trademark.

Sodium Perborate with Calcium Carbonate, flavored—Hennen: Composition: Sodium perborate, N.F.V., 90 per cent; calcium carbonate, U.S.P., 7 per cent; oil of sassafras, 3 per cent.

Actions and Uses: See Sodium Perborate, N.F.V. The calcium carbonate is added to prevent caking.
Distributed by Hennen Products, Wheeling, W. Va. No U. S. patent or trademark.

PHENETIDINE, AMIDOPYRINE AND SALICYL COMPOUNDS

These so-called coal tar antipyretics lower febrile temperatures partly by dilating the cutaneous vessels through a central action, and partly by other mechanisms as yet imperfectly understood. Small doses are efficient analgesics for headache, neuralgic conditions, etc. Listed in the current edition of the Pharmacopeia as used for this purpose are acetanilid, acetphenetidine, amidopyrine and salicylic acid. The salicyl compounds are especially used in the treatment of rheumatic fever. A large number of modifications have been prepared, but these, as a rule,

have not been shown to have advantages over the useful pharmacopeial representatives. In dental practice, their use is, as a rule, limited to their analgesic properties for allaying "preoperative and postoperative pain." Many irrational mixtures of two or more antipyretics and, conversely, analgesics have been introduced; but, as a rule, these have not been shown to have advantages over the individual members of the group. (Uses of Pain Relievers in Fixed Proportions, Report of the Council, *J. A. D. A.*, 18:746 [April] 1931.) As a rule, small doses for analgesic purposes are effective. If small doses are not effective, larger doses should not be used.

These derivatives, in common with benzene derivatives, exert coagulant, irritant, toxic and antiseptic effects on all forms of protein and protoplasm—tissue cells, bacteria and ferments. They produce mild local anesthesia on the terminal endings and give rise to the formation of methemoglobin. These have been used locally in postoperative measures, but on account of the methemoglobin formation, it is preferable to use powdered acetylsalicylic acid for this purpose.

The phenetidines (derivatives of para-aminophenol $C_6H_4[NH_2]$ [OH], 1:4) comprise chemical relatives of analine (aminobenzene). The members of this group have similar properties and are more or less active, accordingly as they undergo decomposition in the system, so as to yield either para-aminophenol or acetylaminophenol. They have a more or less pronounced action on the blood by which they produce hemolysis and destruction of the red blood corpuscles. Hence, when applied on open wounds, they form methemoglobin, and any antiseptic action they may contain is outweighed by this property. They also act as heart depressants.

Acetylsalicylic acid (C_6H_4[OH]COOH) has essentially the actions of sodium salicylate. Its analgesic and antipyretic actions, even in nonrheumatic affections are stronger, possibly because the undecomposed acetyl compounds enter the nerve cells more readily. It has been asserted that when applied in the form of an aqueous paste, it is useful in overcoming temporarily the pain incident to periodontoclastic operative precedure and present after extractions.

The Council desires to point out that the compounds of the group, while useful in the hands of the profession, should be prescribed in such ways as not to encourage self-medication. Many practitioners dispense these drugs in tablet forms, in plain envelopes, containing tablets for a limited course of treatment.

ACETANILID, U.S.P.—Acetanilidium (acetanil.) (Antifebrin) Monoacetyl aniline.—$C_6H_5NHCH_3CO$.

Properties: Acetanilid is an odorless, crystalline powder, having a slightly burning taste. It is only slightly soluble in water (1:190), but freely soluble in alcohol (1:3.4).

Incompatibilities: Acetanilid is incompatible with ethyl nitrite. It forms a semiliquid mass when triturated with chloral hydrate or antipyrin. It is incompatible with acetysalicylic acid and quinine; hence, their use in mixtures is irrational.

Actions and Uses: Acetanilid is an analgesic antipyretic and, in excessive doses, a cardiac depressant. These effects are due to para-aminophenol, into which it is converted in the body.

Moderate doses have little effect on, or tend to increase, the temperature of normal animals and men, but such doses cause a marked reduction of the temperature in fever. In poisonous doses acetanilid causes cyanosis, abnormal reduction of temperature, coldness of the extremities and profuse sweating. In individuals with an idiosyncrasy toward the drug, similar symptoms may be produced by small doses. It should be avoided or used cautiously in patients who are debilitated from any cause, especially those with heart disease. Acetanilid is effective for the relief of headache, neuralgic pain and the aches and pains of the fever patient, but is not suited to the treatment of pain caused by colic or surgical operations.

It has been exploited widely as a universal analgesic in various mixtures and under different names. Many so-called headache powders and "pain relievers" contain it. Its indiscriminate use in such forms is dangerous.

Dosage: 0.2 gm. (3 grain). It is well to begin with 0.1 gm. (about 1½ grains), and to repeat cautiously. It may be administered dry in the form of powder, or in cachets or capsules. Because of its slight solubility, it should not be massed in pills or compressed into tablets unless the tablets are crushed before swallowing or care is taken in the manufacture of the tablet to insure its rapid disintegration in the stomach.

The addition of caffeine (0.06 gm. to 0.1 gm. [1 to 1½ grains] to each dose) renders it more effective against certain headaches. Mixtures of acetanilid with caffeine or ammonium salts

have been recommended on the supposition that the cardiac depression would thus be avoided, but these mixtures have no such advantage.

ACETPHENETIDIN, U.S.P.—Acetphenetidinum (Acetphen.) (Phenacetin) Monoacetyl para-amidophenetol. $C_6H_4(C_2H_5)NHCH_3CO$, 1:4. It differs from acetanilid in containing the ethoxyl group, C_2H_5O.

Properties: Acetphenetidin occurs as white, crystalline scales or crystalline powder. It is odorless and slightly bitter. It is very slightly soluble in water (1:1,310), but soluble in alcohol (1:15).

Incompatibilities: The same as those of acetanilid.

Actions and Uses: Similar to those of acetanilid. The analgesic, antipyretic and cardiac depressant effects of acetphenetidin, like those of acetanilid, are due to the formation of para-aminophenol, and its possible advantages over acetanilid are probably due to the fact that this decomposition occurs more slowly. It is best administered in the form of powders, or in cachets or capsules.

Since the enactment of the Food and Drugs Act, June 30, 1906, acetphenetidin has displaced acetanilid in many proprietary mixtures for the relief of headache and other pain. Its relation to acetanilid suggests similar caution in its use.

Dosage: 0.3 gm. (5 grains). It is well to begin with 0.2 gm. (3 grains) and to repeat the dose every three hours, if needed, for a few doses. When small doses fail to relieve headache, larger doses are also usually ineffective. For mixtures with caffeine, see Acetanilidum.

Phenacetin: A name applied to acetphenetidin. See U. S. Pharmacopeia. The tests of identity and purity prescribed by the U. S. Pharmacopeia under acetphenetidin should apply to the product used under this title.

AMIDOPYRINE, U.S.P.—Amidopyrina (amidpyrin.) (Pyramidon). Colorless, or white crystals or crystalline powder; odorless and almost tasteless; soluble in water (1:18), and readily soluble in alcohol (1:1.5).

Incompatibilities: It is incompatible with spirit of ethyl nitrite, and other nitrites, tannic acid and tannic acid-containing preparations.

Actions and Uses: Amidopyrine acts as an antipyretic and anodyne, similarly to antipyrine, but is effective in smaller doses, being effective in about one-third the dosage. The action, while somewhat slower at the beginning, is more lasting. It is claimed to be comparatively free from harmful influence on the blood, heart and kidney. It is widely used as an analgesic and sedative prior to and after dental operative procedures. The analgesic action is probably enhanced by the simultaneous administration of a small dose of barbituric acid (barbital). If the analgesic action is not effective in small doses, it is improbable that larger doses are of avail. Larger doses should be used cautiously, especially when an idiosyncrasy is present.

Dosage: 0.03 gm. (5 grains) U.S.P., preferably in tablets, should suffice for twenty-four hours.

Pyramidon: A brand of amidopyrine, U.S.P.

Manufactured by H. A. Metz Laboratories, Inc., New York. U. S. patent expired. U. S. trademark.

Pyramidon Tablets: 1½ *grains.*

Pyramidon Tablets: 5 *grains.*

Elixir of Pyramidon: Each 4 c.c. (1 fluid dram) contains pyramidon, 0.162 gm. (2½ grains) in a menstruum containing alcohol 20 per cent.

ACETYLSALICYLIC ACID, U.S.P.—Acidum acetylsalicylicum (aspirin) $C_6H_4O(CH_3CO)COOH$, 1:2. The acetic acid ester of salicylic acid.

Properties: Acetylsalicylic acid occurs as a crystalline, odorless powder with an acidulous taste. It is slightly soluble in water (1:300) and freely soluble in alcohol.

Incompatibilities: It is decomposed by moisture and alkalis into acetic and salicylic acid. It is incompatible with acetanilid and acetphenetidine and quinine.

Actions and Uses: Acetylsalicylic acid acts as do salicylic acid and the salicylates, but it is less nauseant, and it seems to be a more efficient analgesic. Up to 45 per cent passes through the body unchanged. It is employed as an antipyretic, analgesic and antirheumatic. It is much used for the relief of headache and coryza. Acetylsalicylic acid is not free from untoward secondary effects somewhat similar to those of sodium salicylate. It causes urticaria and dangerous acute edema of the respiratory passages in susceptible individuals. It has been used to "allay" preoperative and postoperative apprehension based on its analgesic properties.

The promiscuous use of acetylsalicylic acid under the name "aspirin" by the laity, especially for the relief of headaches and other indefinite pain producing conditions, has frequently led to cases of rather severe poisoning, the chief symptoms being edema of the lips, tongue, eyelids, nose or the entire face, also urticarial rashes.

It has been applied locally in substance for the relief of pain in connection with periodontal disease and applied in sockets after extractions as a local analgesic. It has also been employed as a gargle and mouth rinse, but without convincing evidence of its usefulness.

Dosage: 0.3 gm. (5 grains), repeated once in three hours unless symptoms of salicylism (ringing in the ears, etc.), are noted, or other toxic effects develop. For preoperative and postoperative pain, it is best dispensed in 5 grain tablets or capsules.

It may be administered in the form of a powder, wafers or capsules. As a powder, this may be administered by dissolving in sweetened water, or placing on the tongue, and taking a swallow of water. The powder should be dispensed in wax paper.

PHENOLIC COMPOUNDS

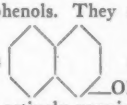
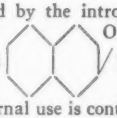
Benzol, C_6H_6, may be considered as the mother substance of the coal tar series. It has a low toxicity for protoplasm because it does not react readily in the presence of protoplasm. The property of reacting in the presence of protoplasm is given by the replacement of hydrogen atoms of the benzene nucleus by other groups, notably by hydroxyl—OH. The antiseptic and toxic actions increase with the number of hydroxyl groups, progressively from phenol C_6H_5OH to resorcin, $C_6H_4(OH)_2$. The position of the introduced groups influence the quantitative behavior. The addition of the groups such as carboxyl (COOH), methyl (CH_3) and other alkyl radicals (C_nH_{2n+1}) in general leads to a quantitative variation in pharmacologic actions.

Phenol is a general protoplasmic poison and a fairly active disinfectant, although not so powerful as mercuric chloride or the cresols. The introduction of alkyl groups into phenol increases the germicidal efficiency. Chemically, the cresols exist in three isomers, para, meta and ortho cresol, but a mixture of these obtained from coal tar is used in practice. The ordinary mixtures contain variable proportions, but for pharmaceutic uses their properties are standardized by methods listed in the various pharmacopeias. The germicidal properties are three or more times as active as the phenol and higher homologues described herein are as much as fifteen times as active as phenol, while the toxicity as a rule is less.

Resorcinol, $C_6H_4(OH)_2$, coagulates albumin. Strong solutions cauterize the skin, while weak solutions are merely antiseptic. In dentistry, it is used in the form of sprays, mouth washes, etc.

Creosote is a mixture of phenols obtained by the distillation of wood, particularly beechwood. The principal constituents are guaiacol, $C_6H_4(OCH_3)OH$, and creosol, $C_6H_3(OCH_3)(CH_3)(OH)$.

In practical use, creosote is used as the creosote or guaiacol which constitutes from 60 to 90 per cent of the creosote. The advantage of using guaiacol lies in its constancy of composition. Formerly creosote was extensively employed in tuberculosis, but the clinical results which were not constant led to its general abandonment. It was introduced into dentistry about 100 years ago as an antiseptic for the treatment of disease of the pulp, and appears to be one of the best agents for sterilization of root canals.

The naphthols are analagous to the phenols. They are formed by the introduction of an hydroxyl group in the naphthalene nucleus  alpha, and  beta naphthol.

They act similarly to phenol but are more actively germicidal. Internal use is contraindicated in the presence of renal disease.

They may be rendered soluble by the addition of soap, as in the official compound solution of cresol, and in several other ways. The variability is best discounted by the determination of the phenol coefficient, that is, the ratio of the germicidal power of the disinfectant to the germicidal power of phenol tested under identical conditions. The Council has ruled that the method for determining the phenol coefficient, together with the test organism and the method employed for the determination, must be stated on the label of a preparation of this class in order to be acceptable. A disinfectant three times as active as phenol against *B. typhosus* would be of the coefficient 3 (this being about the coefficient of compound cresol solution). Most disinfectants are now sold with a statement of their coefficient. The degree of dilution for a

disinfectant is obtained simply by multiplying by 20 the phenol coefficient. For instance, a disinfectant having the coefficient three would be diluted $3 \times 20 = 60$ times.

The official cresol is a mixture of the three isomers of $C_6H_4(OH)(CH_3)$. The "higher homologues," containing two or more methyl groups, are generally referred to as cresylic acid. They have a higher disinfectant coefficient. The toxicity and local actions of the cresols, as of other phenols, may be diminished by making the active OH group through replacement of the H by acid radicals. One such preparation, cresatin (metacresyl acetate), is listed in Accepted Dental Remedies.

The use of antiseptics and germicides in the oral cavity is yet purely empiric. The Council advises dentists to keep this in mind when using antiseptics and germicides. Until more is known definitely of the particular organisms responsible for dental disease, and until specific agents are demonstrably involved, the present situation will remain. (Mouth Washes: Report of the Council, *J. A. D. A.*, 19:1,239 [July] 1932.)

Crude coal tar is a constituent of sheep dips, and in diluted form has been advertised both to the profession and to the public as a "pyorrhea remedy."

ALPHANAPHTHOL.—Alphanaphthol.—1-hydroxy-naphthalene, $C_{10}H_7OH$.

Actions and Uses: The actions of alphanapthol resemble those of betanaphthol. It is antiseptic and germicidal, being several times more actively antiseptic than phenol. When applied to the skin or mucous membrane, it is irritating, and absorption of considerable amounts may cause nephritis. The literature on its toxicity as compared to that of betanaphthol is rather contradictory but it is probably of a similar order. Alphanaphthol is generally not used internally.

Dosage: Externally, solutions containing from 0.1 to 1 per cent of alphanaphthol may be used. As a gargle, mouth wash, etc., solutions containing 0.05 to 0.5 per cent may be used.

Properties: Alphanaphthol occurs as colorless or faint gray glistening crystals, or a white crystalline powder, possessing a faint phenolic odor and a pungent taste; readily soluble in alcohol, ether, chloroform and benzene; very slightly soluble in hot water and practically insoluble in cold water, and readily soluble in aqueous solutions of alkali hydroxides. A saturated aqueous solution is neutral to litmus. Alphanaphthol melts at between 93 and 95 C.

Compound Solution of Alphanaphthol: Alpha-Naph-Co contains alphanaphthol, 10 gm., glycerine, 32 gm., soft soap (prepared from cottonseed oil and potassium hydroxid), 23.8 gm., water to make 100 gm., gluside and essential oils to flavor.

Actions and Uses: See preceding article under Alphanaphthol. When tested against *B. typhosus* by the U. S. Hygienic Laboratory method, Alpha-Naph-Co has a phenol coefficient of 1.46.

Dosage: See preceding article under Alphanaphthol.

Manufactured by the Carel Laboratories, Redondo, Calif. No U. S. patent or trademark.

BETANAPHTHOL, U.S.P.—Betamonohydroxy naphthalene. Betanaphthol (betanaph.) $C_{10}H_7OH$.

Properties: Betanaphthol occurs as colorless or pale buff-colored crystalline laminae or a crystalline powder, having a faint phenol-like odor and a pungent taste. It is only very slightly soluble in water (1:1,000), but it is readily soluble in alcohol (1:0.8).

Actions and Uses: Betanaphthol is several times more actively antiseptic than phenol. It is irritating to the skin or mucous membrane when applied in solution. If absorbed in considerable amount, it may cause nephritis. It tends to destroy the red blood corpuscles and has been known to produce changes in the retina and in the opacity of the lens.

Betanaphthol is applied externally as a parasiticide and antiseptic. Internally, it has been much used as an intestinal antiseptic, but its utility is limited because of the danger of poisoning from its possible absorption.

It has been used in dentistry as an "antiseptic" solution, viz.: betanaphthol, 1 gm. (15 grains); alcohol, glycerine and water to make 30 c.c.

It has been suggested for use an antiseptic cavity varnish as follows: gum copal, 8 gm.; ether, 45 c.c.; betanaphthol, 4 gm.

CRESOL, U.S.P.—A mixture of isomeric cresols, $C_6H_4CH_3OH$, obtained from coal tar, freed from phenol, hydrocarbons and water.

Properties: Cresol occurs as a colorless or yellowish to brown-yellow refractive liquid having

a phenol-like odor and becoming darker on exposure to light or air. It is soluble in water (1:50) and miscible in all proportions with alcohol, petroleum benzene, ether and glycerine. It is miscible with soap solutions and with solutions of alkali hydroxides, yielding an economical disinfectant.

Actions and Uses: Cresol is an active poison resembling phenol in its effects. Its germicidal power is approximately four times as great as that of phenol, but its toxicity is correspondingly decreased. It is used for pulp mummification—an operative method not to be condoned. A suggested formula is: thymol crystals, 8 gm.; cresol, 8 c.c.; zinc oxide, enough to make a stiff paste.

A mixture of equal parts of formaldehyde solutions and cresol has been used in the treatment of putrescent pulps, but views are conflicting regarding the assertion that it is an absolute specific for gangrenous pulp conditions. Cresol is considered by some clinicians as useful in root sterilization; not as a final treatment, but as a first treatment.

CREOSOTE, U.S.P.—(Creosotum, creosot.)—Creosote consists of phenols and phenol derivatives, chiefly guaiacol and creosol. These have essentially similar antiseptic action, resembling that of phenol. Creosote once enjoyed wide use as an intestinal antiseptic, as a stimulating expectorant in bronchitis and in the treatment of tuberculosis, although such uses are being discontinued. Creosote at one time occupied a prominent place in dentistry as an antiseptic in the treatment of infected canals. Its use is almost obsolete, it having been replaced by phenol, cresol and other antiseptics.

Properties: It occurs as a colorless or slightly yellowish, highly refractive, oily liquid, having a penetrating smoky odor and a burning caustic taste. Creosote is slightly soluble in water, and miscible in all proportions with alcohol, ether or fixed volatile oils. Owing to its disagreeable odor and taste, it is seldom administered in the form of solution or mixture.

Actions and Uses: Creosote acts similarly to phenol (which see). It is used to some extent locally in dilute solution for its antiseptic and anesthetic action, but, as already mentioned, it has been replaced by other drugs. A droplet applied to the cavity of a carious tooth will usually relieve toothache temporarily. It is used in substance for the sterilization of root canals. As a result of a study of the relative efficiency from a bacteriologic standpoint of some materials used in the treatment of putrescent pulp canals, Kitchin concluded, in part, that beechwood creosote proved quite consistent in its ability to destroy the organisms of putrescent pulp canals. (*J. A. D. A.*, 18:1,668 [Sept.] 1931.)

Dosage: 0.25 c.c.

Beechwood Creosote, Merck, Hartmann & Hauers'—A brand of creosote, U.S.P.

Manufactured by Hartmann & Hauers, Konstanz, Germany.
Distributed by Merck & Company, Rahway, N. J. No U. S. patent or trademark.

GUAIACOL, U.S.P. Guaiacol.—Guaiacol is composed chiefly of the monoatomic phenol $C_6H_4(OH)(OCH_3)$, obtained from wood creosote or made synthetically.

Properties: Guaiacol is a colorless or yellowish strongly refractive liquid, or a nearly colorless crystalline solid, having an agreeable aromatic odor. It becomes darker on exposure to light, and air. Guaiacol is soluble in water (1:60 to 70), and miscible with alcohol in all proportions.

Actions and Uses: Guaiacol is antiseptic and germicidal, but it is milder than creosote. When rubbed on the skin, it is absorbed. It acts as a useful counterirritant in relieving pain due to pericementitis, when a drop is applied locally to the region of the pain. Diluted with an equal volume of glycerine, its use has been suggested for the alleviation of postoperative pain.

CRESATIN—DR. N. SULZBERGER.—m-Cresyl Acetate—$CH_3C_6H_4O(CH_3CO)$. The acetic ester of metacresol, $CH_3C_6H_4OH$.

Actions and Uses: Cresatin—Dr. N. Sulzberger is said to possess antiseptic and analgesic properties, and is apparently free from toxic effects. When applied to mucous membranes, it is said to cause no irritation, sloughing or discomfort. In benzene solution, it is said to be useful as a root canal germicide (Coolidge, E. D.: *J.A.D.A.*, 16:698 [April] 1929). Further confirmation is desirable.

Dosage: Cresatin—Dr. N. Sulzberger may be employed either in the pure form, or in dilution with oils or alcohol by direct application or spray.

Manufactured by Sharp & Dohme, Baltimore. U. S. patent 1,031,971 (July 9, 1912; expired July 1929). U. S. trademark 80,533.

Cresatin—Dr. N. Sulzberger occurs as a colorless oily liquid, possessing a characteristic

odor. It is practically insoluble in water, but is soluble in the ordinary organic solvents; miscible with liquid petrolatum, fixed and volatile oils and volatile with steam.

PHENOL, U.S.P.—(Carbolic Acid)—Hydroxybenzene—C_6H_5OH. It is obtained from coal-tar by fractional distillation and subsequent purification, or is made synthetically.

Properties: Phenol occurs as colorless, interlaced or separate, needle-shaped crystals, or a white or light pink crystalline mass, having a characteristic, somewhat aromatic odor. When copiously diluted with water, it has a sweetish taste, with a slightly burning after-taste, and, when undiluted, cauterizes and whitens the skin and mucous membranes. Phenol is soluble in water (1:15) and is miscible with alcohol in all proportions.

Actions and Uses: Phenol is antiseptic and germicidal. A solution of 1:850 will prevent the multiplication of bacteria. A 1 per cent solution will usually destroy nonsporulating bacteria in a few minutes at ordinary temperature, but a 5 per cent solution fails to destroy anthrax spores after exposure for twenty-four hours. Phenol is taken as the type or standard for comparing the activity of disinfectants. The "phenol coefficient" means the relative strength of a disinfectant, as compared with phenol acting on the same organism, and for the same length of time. It should be remembered that different micro-organisms show wide differences in their behavior toward antiseptics. Phenol is escharotic when applied to the skin, turning the skin and tissues white. If a finger or other extremity is surrounded with dressings wet even with a dilute solution of phenol, gangrene is likely to appear. Phenol acts as a local anesthetic, but practically is not used as such because of its strong escharotic properties. Phenol has been used as an antiseptic in mouth washes, gargles, and sprays. Superficial "burns" from the action of phenol should be treated by washing with alcohol, glycerine, ether or oil to remove the poison. In phenol poisoning, the stomach may be washed with diluted alcohol, which should be completely removed by washing with water. If left in the stomach, the alcohol will favor the absorption of phenol.

In dental practice, phenol has been used as an obtundent and local anesthetic, either alone or in admixture with camphor, thymol, alcohol, essential oils or mixtures thereof.

Many empiric combinations of phenol with camphor, iodine, salicylic acid, etc., have been used extensively in dentistry. The advances in modern surgery, e.g., excision methods, have displaced "drug surgery." Hypertrophic tissues, which formerly were cauterized with phenol, are now removed by surgical means.

Because of its caustic action, it is used to devitalize pulps or temporary teeth.

"Camphorated Phenol": A solution of phenol and camphor in liquid petrolatum: phenol, 8 gm.; camphor, 16 gm.; liquid petrolatum, 16 c.c. Alcohol may sometimes be used as a solvent: phenol, 30 gm.; camphor, 60 gm.; alcohol, 10 c.c. A phenol, thymol and camphor mixture is used for treatment of putrescent pulps: phenol, 8 gm.; thymol, 8 gm.; camphor, 4 gm.

Odontalgium, N.F.V.: A mixture made by dissolving phenol, 20 gm., in oil of cinnamon, 10 c.c., and methyl salicylate, 30 c.c.; Black's well known 1-2-3 mixture.

RESORCINOL, U.S.P.—Resorcinol (resorcin.) Metadihydroxybenzene ($C_6H_4[OH]_2$ 1:3.)

Properties: Resorcinol occurs as colorless or nearly colorless needle-shaped crystals, having a faint peculiar odor and a sweetish taste, followed by a bitter taste. It is readily soluble in water (1:0.9) and in alcohol (1:0.9).

Actions and Uses: Resorcinol is antiseptic, antizymotic and antipyretic. On account of the readiness with which it causes the formation of methemoglobin and the danger of its producing collapse, it is seldom used internally. Applied externally, it is astringent in from 1 to 3 per cent solutions, and produces exfoliation of the epidermis in concentrations of 10 to 20 per cent. In 20 per cent solution, it has been used as a mouth wash.

POTASSIUM CHLORATE, U.S.P.—Potassii chloras (pot. chloras.) $KClO_3$.

Properties: Potassium chlorate is explosive when mixed with oxidizable matter, and caution should be observed in manipulating it. It occurs as colorless crystals or a white granular powder, odorless and having a cooling and characteristic taste. It is soluble in water (1:11.5), but nearly insoluble in alcohol.

Actions and Uses: Potassium chlorate is widely used as a mouth wash in various forms of marginal gingivitis and stomatitis; particularly mercurial stomatitis. It is held by some to be the agent of choice after the discontinuance of mercury medication. It is also used as a gargle in pharyngitis and tonsillitis, and occurs as a constituent of some dentifrices. It is excreted

almost unchanged. Large doses, and continued small doses, given internally, are toxic because of methemoglobin formation, and disintegration of the blood corpuscles, and injury to the kidney may result in nephritis. Chlorate has been used to produce experimental nephritis in animals. The toxicity is variable. Whether absorption of chlorate occurs from its use in the mouth under dentifricial conditions and in the presence of hyperemia and ulcerations is not definitely known. Such absorption has been suspected. In view of the complete absence of proof of its therapeutic efficiency, the indiscriminate use of chlorate mouth washes and dentifrices is to be regarded as potentially harmful, and there is no doubt of danger when it is swallowed in appreciable amounts.

Dosage: A saturated solution may be used as a mouth wash or gargle.

POTASSIUM PERMANGANATE, U.S.P.—Potassii permanganas (pot. permang.) $KMnO_4$.

Properties: Potassium permanganate occurs in slender prisms, a dark purple, almost opaque by transmitted light and of a blue metallic luster by reflected light, odorless and having a taste which is at first sweet but afterwards disagreeable and astringent. It is soluble in water (1:13.5) and decomposes when brought in contact with alcohol.

Actions and Uses: Potassium permanganate is a deodorant, germicide, irritant and astringent, the action depending on the concentration. It has marked oxidizing properties. It is used for affections of the mucous membrane in dilutions of 1:5,000 to 1:1,000. A solution of the latter concentration is used in Vincent's infection.

Potassium permanganate, on account of its oxidizing properties, is commonly used for the destruction of organic poisons while still in the stomach, but it should not be employed to the exclusion of gastric lavage. It is of little value when the stomach contains much organic matter, since potassium permanganate oxidizes most organic matter. In the form of a solution, 0.1 per cent, it is used as a mouth wash for diseases of the soft tissues.

It is used to disinfect the hands in surgery. The hand is dipped into the disinfectant solution until it is mahogany brown, and then dipped into a warm saturated solution of oxalic acid and rinsed in sterile water.

Dosage: Potassium permanganate is not, as a rule, used internally. For local treatment, it is used in solutions of 1:5,000 to 1:1,000.

KOLYNOS DENTAL CREAM AND SOAP

Recently, the Kolynos Company, manufacturers of Kolynos Dental Cream, circularized the dental profession. Their letter quoted the Council on Dental Therapeutics in reference to soap in dentifrices. The letter states:

"The fallacy of the criticism of the soap-content of Kolynos is further indicated in the report on Kolynos written to The Kolynos Company by the Council on Dental Therapeutics of the American Dental Association, which states as follows:

"'The composition (of Kolynos Dental Cream) reveals nothing of a harmful nature and appears to be in line with the "specifications" for dentifrices adopted by the Council. There is no acceptable evidence that dentifrices containing soap to the extent of 20% are harmful.'" This statement is at variance with the report published by the Council holding Kolynos Dental Cream not acceptable for A.D.R. because it was marketed with claims which were not supported by adequate evidence. In that report the Council stated:

"While there is a great deal of discussion in the dental literature bearing on the beneficial and harmful effects of soaps in various amounts, there is no acceptable evidence that tooth pastes containing soap to the extent of 20 per cent are harmful. *Neither is there any pointed evidence available that it is beneficial to the soft or hard tissues of the mouth, or that it acts as an efficient cleansing agent.*"[1]

Indeed, experiments undertaken for the Council by the South Bend (Ind.) Dental Society revealed that the use of Kolynos Dental Cream, as directed, did not cause any noticeable change in the shade of the teeth as claimed by the company in their public advertising.

This statement is made that the dental profession may be in a position to answer "those patients who bring up the question of the soap-content in Kolynos."

SAMUEL M. GORDON, *Secretary.*

1. J. A. D. A., 19:328-330 (Feb.) 1932.

BUREAU OF PUBLIC RELATIONS

STANDARDIZATION OF DENTAL EXAMINATION CHARTS FOR CHILDREN

By F. BLAINE RHOBOTHAM, D.D.S., Chicago, Ill.

At the annual meeting of the American Dental Association in 1930, Frank A. Delabarre, chairman of the Committee on Standardization of Dental Examinations, gave a report before the Section on Mouth Hygiene and Preventive Dentistry, setting forth the idea that there was need for an accurate method of collecting dental data.

At the White House Conference for Child Health and Welfare, conducted by the last administration, the dental members were embarrassed by the fact that the data available were not of sufficient accuracy to meet requirements.

The need for a more careful method of collecting reliable data has been pointed out by many members of the dental profession, among them Thaddeus P. Hyatt, Alfred Walker, Lon W. Morrey and Herbert E. Phillips.

In 1932, the American Society for the Promotion of Dentistry for Children appointed a committee to study and prepare a standardized chart for dental examination of children. As a result of that study, the accompanying chart has been prepared. Credit is here given to the writings of those mentioned and to a host of others who have contributed in many ways to the development of this chart. Statisticians, research workers and outstanding men of special experience were consulted. Several men of the medical profession were consulted and an effort was made to present a broad view of our common problems. Special mention is due several of the officers of the American Academy of Pediatrics.

Although the method of recording the findings is recommended as ideal for the type of information to be gained, the committee feels that that phase of the record is secondary to the method suggested for standardization.

There are four methods of standardization that the Committee believes should be used on every dental examination chart in order that, in summarizing, collected data can be accurately compiled.

These four methods are as follows:

1. By whom is the information given? This is necessary to standardize the authority of the statements which are vital to the accuracy of the entire record.

2. For what purpose is the examination made? Dental examinations vary in completeness and detail in direct relation to the purpose for which they are conducted.

3. By whom is the examination made? This classifies the qualifications of the examiner.

4. What type of examination is employed? This classifies the specific instruments and technic used.

As the record definitely sets up a form by which a check in a square will indicate

the foregoing, it becomes a very easy matter to standardize all charts, simple or complex.

In further explanation of the chart suggested, as a sample of the findings to be recorded, brief comments are submitted.

You will note that the general plan of the chart is to place as many notations as possible that have an essential fact-finding value in such a manner that a check is the only requirement. This will conserve the time of the examiner, and at the same time simplify the summarizing. The squares are numbered so that later, when the checked squares are punched, the record can be placed in a tabulating machine.

Although there seems to be a great deal of printing on the chart, it can be readily seen that only the items that apply to the case need be checked. This will give a very comprehensive number of data without a great amount of work on the part of the examiner.

These examinations should be made in the presence of a parent for two important reasons. The first one is accuracy, of course; the second, that the dental profession is afforded the best possible opportunity to educate the parents as to the value of adequate care of children's mouths.

The chart should be numbered for statistical purposes.

The name should be placed on the record for identification purposes.

The address is essential to determine conditions in states and parts of states and geographic relationships, and to differentiate between urban and rural conditions.

The data as to male or female are useful for comparative studies as regards sex.

The date of birth and date of examination are essential to determine the exact age.

The actual age refers to the nearest birthday, so that the age groups can be studied easily without computing the age in years, months and days in cases wherein the study does not require it.

The place of birth is important that further geographic studies may be made when the problem is studied.

The nativity of the parents is useful in studies of racial influences.

The race is important in making racial comparisons.

The facts ascertained in regard to bottle feeding or breast feeding are particularly important in studies of rachitis and hypoplasia.

The record of school progress is essential in determining the relation of oral conditions to reeducation.

The record of kinds of schools attended makes possible a comparative study of conditions in the various types of schools.

The record of dental care brings out the value of such service.

The record of home care will afford an interesting check-up on its value.

The report on oral hygiene conditions can be studied in relation to home care, dental care, diet, habits, diseases, etc.

A record of adequate food essentials will show their all important relationships to general health, oral health, growth, development, incidence of caries and gingivitis, etc.

Temperament studies will be important as relates to the effect on temperament of adverse oral conditions.

An adequate study of habits in their relation to occlusion will bring out their importance as a factor in malformation and malposition.

The simplest method of recording malocclusion was used to avoid misunderstanding of replies.

The physical record includes only the most important items. We were desirous, in this record, to give a general physical

NAME | 1 ☐ MALE 2 ☐ FEMALE | DATE OF BIRTH / PLACE OF BIRTH | DATE OF EXAM. / ACTUAL AGE | CHART NUMBER / SCHOOL GRADE

LAST FIRST

CITY OR COUNTY STATE

NATIVITY: FATHER / MOTHER

RACE: 1 ☐ WHITE 2 ☐ BROWN 3 ☐ YELLOW 4 ☐ RED 5 ☐ BLACK 6 ☐ MIXED

SCHOOL: 1 ☐ PUBLIC 2 ☐ PAROCHIAL 3 ☐ PRIVATE 4 ☐ INSTITUTIONAL

HISTORY BY
1 ☐ PARENT
2 ☐ CHILD
3 ☐ NURSE

EXAMINATION BY
1 ☐ DENTIST 4 ☐ PHYSICIAN
2 ☐ HYGIENIST 5 ☐ NURSE
3 ☐ DENTAL STUDENT 6 ☐ TEACHER

PURPOSE
1 ☐ RESEARCH 4 ☐ SCHOOL CLINIC
2 ☐ PRIVATE PRACTICE 5 ☐ DETACHED CLINIC
3 ☐ HOSPITAL 6 ☐ SURVEY

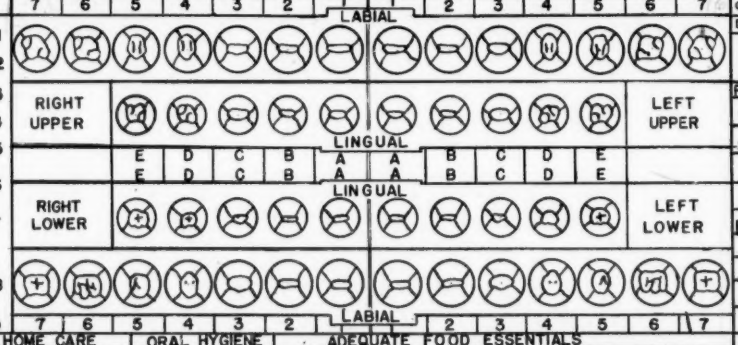
TYPE OF EXAMINATION
1 ☐ TONGUE DEPRESSOR ONLY
2 ☐ SHARP EXPLORER AND MIRROR ONLY
3 ☐ SAME AS (2) PLUS DRY TEETH AND ILLUMINATION
4 ☐ SAME AS (3) PLUS RADIOGRAPHS
5 ☐ SAME AS (4) PLUS STOMATOSCOPE

SCHOOL PROGRESS
1 ☐ EXCELLENT 3 ☐ POOR
2 ☐ NORMAL 4 ☐ RETARDED

INFANCY FEEDING
1 ☐ BREAST FED — NO. OF MONTHS
2 ☐ BOTTLE FED — NO. OF MONTHS

1 ☐ CHECK HERE IF PROPHYLAXIS PRECEDES EXAMINATION

KEY
CAVITY 1
FILLING 2
INFECTED TOOTH 3
GINGIVITIS 4
RETAINED ROOTS 5
EXTRACTION INDICATED 6
PULP INVOLVED VITAL 7
PULP INVOLVED NON-VITAL 8
HYPOPLASIA 9


7 6 5 4 3 2 1 LABIAL 1 2 3 4 5 6 7
RIGHT UPPER
LEFT UPPER
LINGUAL
E D C B A A B C D E
RIGHT LOWER
LEFT LOWER
LINGUAL
7 6 5 4 3 2 1 LABIAL 1 2 3 4 5 6 7

CAVITIES DEC.	CAVITIES PER.	FILLINGS DEC.	FILLINGS PER.	INFECTED TEETH DEC.	INFECTED TEETH PER.	GINGIVITIS DEC.	GINGIVITIS PER.

RECORD OF OTHER FINDINGS

TEETH LOCATED BY RADIOGRAPHS

SUPERNUMERARY TEETH

REMARKS

DENTAL CARE
1 ☐ REGULAR
2 ☐ OCCASIONAL
3 ☐ NONE

HOME CARE
1 ☐ REGULAR
2 ☐ OCCASIONAL
3 ☐ NONE

ORAL HYGIENE
1 ☐ GOOD
2 ☐ FAIR
3 ☐ POOR

ADEQUATE FOOD ESSENTIALS
1 ☐ MILK 4 ☐ WHOLE GRAINS 7 ☐ SUNBATHS
2 ☐ FRUITS 5 ☐ MEATS, EGGS 8 ☐ VITAMIN D
3 ☐ VEGETABLES 6 ☐ COARSE FOODS 9 ☐ EXCESS SWEETS

TEMPERAMENT
1 ☐ PHLEGMATIC
2 ☐ NORMAL
3 ☐ NERVOUS

HABITS
1 ☐ THUMB SUCKING 4 ☐ LIP BITING 7 ☐ RESTING ON HAND
2 ☐ FINGER SUCKING 5 ☐ TONGUE BITING 8 ☐ SLEEPING ON HAND
3 ☐ MOUTH BREATHING 6 ☐ CHEEK BITING 9 ☐ PACIFIER

OCCLUSION
1 ☐ UPPER PROTRUSION 4 ☐ OPEN BITE
2 ☐ LOWER PROTRUSION 5 ☐ OVER BITE
3 ☐ CROSS BITE 6 ☐ IRREGULAR

INSTRUCTIONS
1 As each tooth is examined, place a ring around the number or letter indicating the tooth.
2 If there is no ring placed about the number or letter indicating the tooth, it indicates tooth missing.
3 Any section of the chart not used in examination should be marked N.X.
4 Roots are considered as teeth present.
5 Mark cavity or filling by placing key number on tooth diagram.
6 Mark other conditions by placing key number below tooth on the chart.

PHYSICAL RECORD

HEIGHT
WEIGHT
1 ☐ NORMAL WEIGHT
2 ☐ UNDER WEIGHT
3 ☐ OVER WEIGHT
1 ☐ GOOD POSTURE
2 ☐ POOR POSTURE
1 ☐ ADENOIDS IN
2 ☐ ADENOIDS OUT
1 ☐ TONSILS IN
2 ☐ TONSILS OUT
3 ☐ TONSILS LARGE
1 ☐ SPEECH NORMAL
2 ☐ SPEECH DEFECTIVE

DISEASES	AGE
1 ☐ MEASLES	
2 ☐ WHOOPING COUGH	
3 ☐ CHICKEN POX	
4 ☐ SCARLET FEVER	
5 ☐ DIPHTHERIA	
6 ☐ TYPHOID FEVER	
7 ☐ MUMPS	
8 ☐ INFANTILE PARALYSIS	

REMARKS

EXAMINED BY

Standardized dental examination chart.

picture of the child examined. Thus the growth and development of the whole body may be studied in relation to the growth and development of the structures related to the mouth. We were interested further in the relation of the adenoids and tonsils to oral conditions. We were concerned also as to the relationship of missing teeth and malformed dental arches to speech defects. The record of childhood diseases as related to the whole problem of dental health, particularly to hypoplasia of teeth and bony development, seems important. The age at which the diseases occurred is essential.

There are many more reasons for including the various items in the data which are self-evident. There are also many others which can be secured by further study of the possibilities of the chart record. We are endeavoring only to outline in brief the statistics that might be gleaned from such a comprehensive chart. By cross-checking the findings, there could be any number of problems studied.

You will note that each tooth is shown on the diagram so that every surface is presented. The permanent teeth are numbered from 1 to 7, starting from the median line and counting from center to left, and from center to right, 1 representing the central incisor; 2, the lateral incisor; 3, the cuspid; etc. The deciduous teeth are represented by capital letters beginning with *A*, central incisor; *B*, lateral incisor; *C*, cuspid, etc.

Sufficient space is left about each tooth on the chart that the key numbers may be placed beneath each one in making the record.

The record of fillings and cavities can be made simply by placing the key number on the area of the tooth examined. If the filling or cavity extends over more than one surface, the key number is placed over the several surfaces, but if there are several fillings or cavities in the same tooth, the key numbers are repeated on each surface involved.

The record of areas of gingivitis should be made by placing the key number on the area or areas about the tooth. The record of the other findings should be marked by placing the key number below the tooth examined.

When a tooth is examined, a ring is placed around the number or letter representing the tooth. This will show that the tooth has been examined. When no ring appears around the number or letter representing the tooth, the tooth is missing. This is very important, for it is possible by this means to show both the deciduous and the permanent tooth in the same place in the mouth at the same time. It also shows that each tooth present has been examined, and accurately shows missing teeth.

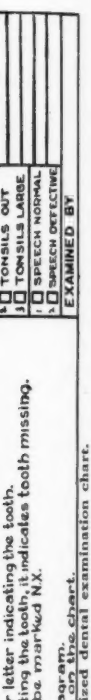
Retained roots are considered as teeth present.

When any section or item of the chart is not included in the examination, it should be marked NX, indicating that the examination was not made. This is very important for statistical accuracy.

To the right of the diagrams representing the teeth, you will note that space is allowed for a partial summary, the recording of other findings and remarks. Under "Cavities" is a space to place the total number of cavities in the permanent and deciduous teeth of the patient examined. The recording of the total number of "Fillings," "Infected Teeth," and "Areas of Gingivitis," are also placed in this section of the chart.

There is sufficient space supplied here for the totalling of any other special findings, but the plan is to have a summary chart prepared to be used in the recording of the accumulated data.

There is space provided for "Remarks" that might be pertinent to some special cases.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3 Any section of the chart not used in examination should be marked NX.
4 Roots are considered as teeth present.
5 Mark cavity or filling by placing key number on tooth diagram.
6 Mark other conditions by placing key number below tooth on the chart.
Standardized dental examination chart.
EXAMINED BY
TONSILS OUT
TONSILS LARGE
SPEECH NORMAL
SPEECH DEFECTIVE

That part of the record at the top of the chart that deals with the four special means of standardization, viz. "(1) History Given By," "(2) Examination Made By," "(3) Purpose of the Examination," "(4) Type of Examination," has been discussed. Note, as an example, however, what a different finding you would expect to record if in checking the number of infected teeth, you used type four instead of type one.

55 East Washington Street.

ANNUAL REPORT 1932-1933 OF THE DENTAL SECTION OF THE CARLETON COLLEGE* HEALTH SERVICE

By WILLIAM A. GREY, D.D.S., St. Paul, Minn.

THE primary function of the dental health service at Carleton College, Northfield, Minn., has been to educate the students to an appreciation of the value of mouth health and its relation to general health. Existing defects are brought to their attention, and the importance of having these defects corrected is emphasized.

Complete case records have been kept, with all data carefully compiled so that it may be used as material for research. A report of the first two years' work[1] was published in March, 1933.

With the reorganization of the health service in the fall of 1932, the dental section was given additional space, and at present there is a separate room for examinations, an x-ray room with lead screen for protection of the operator and space for the development and mounting of x-ray films and the keeping of records. The space and arrangements are adequate and well suited to our purpose.

Eight hundred and fifteen students have received the standard fourteen-film roentgenographic and general examination during the past year. A careful examination was made without the aid of the roentgen rays, and the findings recorded. Then the films were studied, and a separate record was made of the conditions which would not have been found had not the roentgen rays been available. The diagnosis was then based on a consideration of the findings of both examinations. Conditions present, as well as our suggestions for their correction, were then explained to the student, and he was advised to take the roentgenogram and diagnosis to his dentists. If the mouth was found to be in a state of health which might be improved by more efficient home care, an appointment was made for instruction in correct daily care of the mouth, if the student so desired. A brief summary of the findings from the examinations of the students' mouths is given in the accompanying tabulation:

Students examined	815
Cavities found without the use of roentgen rays	3,313
Additional cavities found with the aid of roentgen rays	1,242
Cavities found	4,553

*Northfield, Minn.

1. Grey, W. A.: Dental Section of Carleton College Health Service, J.A.D.A., 20:541 (March) 1933.

Average number of cavities per student	5.3
Percentage of cavities found with the aid of roentgen rays	27
Average number of restorations made by students' dentists after examination	3

In the examination of 815 students, 148 pulpless teeth were found, chiefly with the aid of the roentgen rays. According to our interpretation, a pulpless tooth is one from which the pulp has been removed and the root canals have been partially or entirely filled. Fifty-two abscessed teeth were found. Abscessed and pulpless teeth are considered potential foci of infection. We advised the extraction of definitely abscessed teeth unless there was a possibility that they might be restored to a healthy condition. At the suggestion of C. H. Mayo and E. C. Rosenow of the Mayo Clinic, the medical service was consulted concerning the general systemic condition of students having pulpless teeth not showing definite areas of infection. In those cases wherein pulpless teeth might be considered foci of infection, removal was advised. The medical service was also consulted in other cases, such as periodontic and in cystic formations, etc., which are very likely to be factors in the general systemic condition of the student.

The extraction of 251 teeth was recommended in the examination of 815 students. Before any extractions were recommended, careful consideration was given to the students' general health, and also to the preservation of the dental arch from the standpoint of function and esthetics.

Large cystic formations, involving extensive destruction of the jaw bone, were found in the mouths of four students. These conditions are serious, and if they had not been discovered, they might have caused irreparable damage.

The examination of 815 students revealed that 619 teeth had been extracted for various reasons. As all of these teeth were essential in the dental arch for health, mastication and esthetic considerations, we feel that if the importance of the preservation of the teeth, and the maintenance of a healthy mouth had been emphasized earlier in life, and the mouth checked periodically, a large percentage of these teeth might have been saved.

The roentgenograms disclosed 165 impacted teeth, most of which were third molars. In accordance with our judgment, these teeth, owing to their malposition, can never come into proper functional relationship with the other teeth in the arch, and are likely to cause neuralgia, an inflammatory condition of the surrounding tissues extending back into the throat region and injury to adjacent teeth resulting. We have advised the removal of almost all of this group, since we feel that many of these conditions can be avoided by early detection and removal of impacted teeth.

As regards the attitude of the students toward the work of the dental service, it is not only our opinion, but also that of the deans of the college, that, in general, they evidence cooperation and appreciation. It has been very gratifying to see the amount of recommended work which has been carried out for students between yearly examinations.

An illustrated lecture was given to the freshman class at the beginning of the college year. We discussed the characteristics and value of a healthy mouth as contrasted with the diseased conditions so often found, placing special emphasis on preventive rather than curative measures.

The seven Northfield dentists have given the dental service their fullest cooperation and have been a stimulus to the work of the department. They have

very generously given their time for the examination of students.

During the college year, fifteen members of the administration and faculty came in at the suggestion of their dentists or of their own volition for a complete roentgen-ray examination, for which each one was charged $5.

As a part of the college health program, it was decided, in the fall of 1932, that an investigation should be made of the mouth condition of all college employes engaged in the handling of food. The same type of roentgen-ray and general examination as that given the students was given forty-three food handlers. The nominal fee of $1 each was charged. There is little doubt that a large number of this group were made to realize the importance of mouth hygiene and of having necessary dental work done. After these examinations an evening lecture was given to this group, covering the same material as that given the freshmen.

During the past two years, Dr. Branstad, cooperating with Dr. Stork, has made about 200 lantern slides from the roentgenograms of interesting and unusual cases examined in the dental service. These are used as illustrative material for lectures, etc.

The dental service had an exhibit presenting some of its procedures and results at the fiftieth anniversary meeting of the Minnesota State Dental Association in February, 1933, which was held in Minneapolis. This exhibit aroused considerable interest.

During the past year, there have been several interesting and instructive meetings in connection with the health service. The first, held in November under the auspices of the Rice County Dental Society, was attended by representative dentists of the Twin Cities and of the staff of the School of Dentistry, University of Minnesota. The afternoon was devoted to an inspection of the dental service, with a view to obtaining any constructive criticism they might offer, and a lantern slide lecture on the findings of the department was given. Dinner was served at the college tea rooms for sixty-five guests, after which Boyd S. Gardner of the Mayo Clinic gave a most interesting and instructive lecture which was enthusiastically received.

A meeting of the local physicians and dentists was held in February. The work of the entire health service and its relation to Northfield practitioners was fully discussed.

Dr. Diehl, director of the University of Minnesota Health Service, spent a day in March at Carleton inspecting the health service. Dinner was served at the college tea rooms to more than 100 members of the St. Olaf and Carleton faculties, Northfield physicians and dentists and their wives, and the public school teachers. Dr. Diehl spoke on the University health service, and all were impressed with the efficient way in which the work is being carried on there, first from the standpoint of the students, and secondly, from the standpoint of research.

Looking forward to the future, our policy will be to continue the development of a program of mouth health education, and the maintenance of records which can be used for research.

Appreciation is expressed for the generous cooperation of President Cowling and the faculty as a whole.

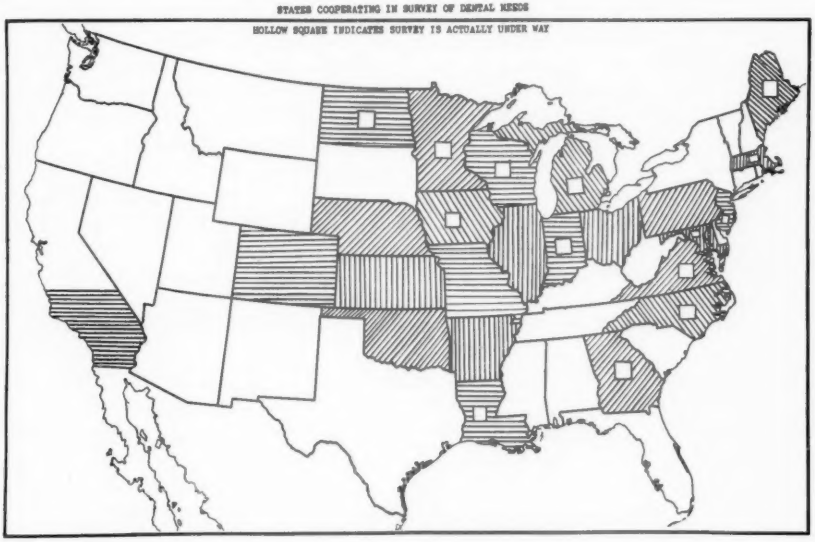
PROGRESS REPORT OF THE AMERICAN DENTAL ASSOCIATION COMMITTEE FOR DENTAL HEALTH SURVEY*

SURVEY OF FACILITIES

THE Committee for Dental Health Survey is directed to: "1. Conduct a survey of dental activities in state, city and local health, educational and welfare departments and state institutions."

The U. S. Public Health Service has made personal surveys of the state departments of health, education and welfare, and state independent commissions of the following states: Arizona, Connecticut, Delaware, Indiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New Hampshire, New Mexico, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia and Wisconsin.

The following states which have little or no dental activitiy are being surveyed by mail: Arkansas, Kansas, Idaho, Montana, Nebraska, North Dakota, Oklahoma, South Dakota, Texas and Wyoming.



It is contemplated that about nine of the remaining twenty states will require personal surveys.

SURVEY OF NEEDS

The Committee for Dental Health Survey is directed also to: "2. Conduct a survey to determine the dental needs throughout the United States (this survery to be confined to kindergarten and

*Dec. 19, 1933.

*C. T. Messner, Washington, D. C., Chairman.

grade school children, and selected adult groups in institutions where practicable)."

Sept. 18, 1933, a letter was mailed to the secretaries of all state dental societies requesting their cooperation and participation in this nation-wide survey. To date, twenty-four states have agreed to participate, as shown in the accompanying map. These states are: Arkansas, California (Southern), Colorado, Georgia, Illinois, Indiana, Iowa, Kansas, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Jersey, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Virginia and Wisconsin.

Examination blanks are being forwarded to fourteen of these states. Organizations are being perfected in the remaining ten states, and examinations will be under way in a short time. Five additional states (not marked on map) have advised us that the program is under consideration by the state dental society officers.

To date, 1,467,758 examination blanks have been distributed in these states.

The Public Health Service has made provision for all completed blanks to be sent from the various districts to the Public Health Service without cost to the dental societies.

We are at present perfecting the organization for the tabulation of the completed examinations. Authority has been obtained to employ ten additional people for this purpose. One of these employes will be an experienced statistician; the remainder will be operators of tabulating machines. This additional personnel started work Jan. 1, 1934. The punch card system will be used for tabulating these records. We have available three punching machines and one verifier. An additional punching machine and three verifiers will be rented.

PUBLIC INSTRUCTION IN TOOTHBRUSHING

By GEORGE H. WANDEL, D.D.S., Riverside, Ill.

THE house of public health dentistry needs cleaning and needs it badly. It is dusty and cluttered with worn-out policies and programs that are without definite objectives or accomplishments. There is a great need for leadership and study in this field for purposes of correlation, standardization and the elimination of wasteful and unsound methods. One has only to study the situation to appreciate the wide disorder that exists. We cannot expect to accomplish very much as long as we continue without laying down definite lines of procedure for each phase of the numerous problems arising in this field.

It is well recognized in public health work that public education is of prime importance. It is also well known that information given to the public must be readily understood, useful and generally consistent. Such is not always the case with respect to the dental activities carried on in the interests of public health. Take for example the question of brushing the teeth.

The matter of tooth cleanliness is universally accepted by the dental profession as essential to the health of the teeth and gums. It is being recognized more and more by the lay public as a necessity in social and in business life. But there is

widespread ignorance, as well as inconsistency, apparent in the knowledge and practice of toothbrushing. There are several reasons for this condition. One cause is the divergence of opinion existing among the members of the profession. One group adheres to one system and another group to some other system of brushing. A person removing from one community to another and necessarily changing dentists is frequently exhorted to alter his technic of brushing. After this has occurred several times, he begins to wonder and probably is not a little confused. Then, too, we cannot deny the fact that there are many practitioners who gave little or no instruction to their patients regarding brushing. As a result, there are too many patients who are dependent on instructions given out by tooth paste manufacturers. Here, again, they become confused; for if the patient changes from one type of brush or tooth paste to another, he is quite apt to be greeted with a change of instructions in brushing technic. The manufacturers are not to blame for this situation. The dental profession is at fault because it has never adopted any set form of toothbrushing instruction, nor has it endeavored to secure the cooperation of the manufacturers in such an effort.

Now, if such is the predicament of the 20 per cent of our population who are said to secure dental service, how much more confusing must be the situation of the remaining 80 per cent who do not come in contact with the dental practitioner. Add to that bewilderment the toothbrushing instructions presented to the public over the radio and in printed form by various local and state health organizations as well as in public addresses delivered by representatives of the profession. All too often, in these cases, the technic presented is one that is governed by individual preference, based not so much on an appreciation of the purpose that it is to serve as on a desire to be different or to further a technic devised by a friend. And this brings up other important points for consideration: There are toothbrushing technics that are fairly simple to explain and relatively easy to learn, and there are others that are difficult to describe and just as hard to practice correctly. Also, some technics are, to all appearances, designed largely for tooth cleansing with slight stimulation of the gums in mouths which present reasonably normal conditions. Others appear to meet the requirements of disease treatment, especially where gum tissue involvement is more or less pronounced. This situation makes it apparent that for purposes of public education, reaching the 80 per cent who are now largely dependent for their information on other sources than the private practitioner, the simpler toothbrushing method must be preferred to the one which is difficult to learn and which depends on personal supervision and instruction for its effectiveness. In other words, until those of that 80 per cent group came under the personal supervision of the dental practitioner, we must furnish them with a brushing method which they can understand and use. The method must insure a minimum of danger and a reasonable amount of benefit. It should be offered as the method which meets the requirements of people as a whole whose teeth and gums, especially the latter, are reasonably healthy. It should be made clear to the public that there are other methods of brushing the teeth which might be better suited to individual needs, but that such information must be obtained under the supervision and guidance of the dental practitioner. If such a plan of public approach can be inaugurated, it will do two things: 1. It will offer to the general public a method that is universally en-

dorsed by the profession. It will do away with confusion in the public mind and will immediately make it apparent that the dental profession and not the various toothbrush and tooth paste manufacturers are determining the fashion in mouth cleanliness. 2. It will give a new prestige to toothbrushing that it has never before enjoyed. If people realize in respect to brushing their teeth that they are doing the least they can do for themselves or can be taught to do by "remote control," they will become more desirous of recognizing their specific needs under the direct supervision of the private dental practitioner.

Our profession must awaken to the fact that it must be responsible for the proper education of the public in dental matters. It must develop in the minds of laymen the realization that the dental profession is the primary source of such information. It must obtain the cooperation of all groups—teachers, nurses, hygienists, dentists, public health organizations and manufacturers—in order to bring this about. This may mean the sacrifice of personal ambition here and there, but the end-result will be beneficial to the public and to the profession. Toothbrushing has long been one of our most emphasized points in public education. It should now be so developed and presented to the public that misunderstanding and confusion are erased. This should be one of the first steps toward cleaning the house of public health dentistry.

With this thought in mind, a questionnaire was sent to 210 selected representatives of the dental profession in all sections of the country. We attempted to obtain geographic coverage and intentionally sent the questionnaires to persons who were known to be interested in public education and yet were thoroughly conversant with the problems that are faced in attempting to teach the public how to brush the teeth. Most of the persons approached were of the general practitioner class, yet there were some who were college deans and others who were specializing in periodontia or in children's dentistry. With the questionnaire, we sent a short letter, explaining principally that we desired an opinion as to the tooth-brushing method thought to be best suited for use in public instruction. We gave a choice of three methods most generally advocated. Following is a copy of the questionnaire.

In order that we may definitely recommend to the public a simple, yet reasonably acceptable method for brushing the teeth, I advocate the method checked below.

1. Charters method_____
2. Rolling method (from gums toward occlusal or incisal aspect)_____
3. Rotary or circular method (Fones)_____

Remarks _____

Signed:

To the 210 questionnaires sent out, we received 152 replies. These replies have been tabulated as follows:

1. Charters method, 32.
2. Rolling method, 74.
3. Rotary or circular method, 19.

The remaining votes were cast as follows:

Twelve voted for a combination of the Charters and rolling methods.

Three voted for a combination of the rolling and rotary methods.

One voted for a combination of the Charters, rolling and rotary methods.

Four stated a preference for the Charters method in adult instruction, and the rolling method in child instruction.

One stated a preference for the Stillman or modified Charters method for adult instruction and the rotary method for child instruction.

Two suggested brushing in all directions.

One advocated the Charters method where disease existed, and the Stillman method in normal cases.

One advocated a combination of the Charters, Stillman and Quinby methods.

One voted for the Stillman method.

One suggested that the public use any method that cleaned.

There are several interesting points brought out in this survey. It will be observed that the rolling method received more than twice as many votes as its nearest rival, the Charters method. Now, this result must not be interpreted as indicating that the rolling method is the best method for brushing the teeth, under all conditions. It merely indicates that a majority of the voters concur in the belief that the rolling method best meets the requirements of public teaching, being easy to explain, easy to learn, and reasonably effective from the standpoint of gum stimulation and tooth cleaning. There was a sufficiently heavy vote in favor of the Charters method to make one wonder whether a carefully controlled survey to determine the relative merits of various toothbrushing methods might not show a surprising reversal of opinion. Such a survey could be carried out in a number of ways under careful and impartial supervision and should brings out some valuable information. In fact, one dentist in sending his reply to the questionnaire voted for the rotary or Fones method and stated that the rolling and rotary methods were tested out under careful supervision on ten persons and the rotary method proved to be the most efficient. Our idea of a competitive test would involve many more persons and the use of the various plans now in vogue in presenting toothbrushing instruction to the public. Tests of all methods could be made through the use of printed instructions, verbal instructions as they are limited in a radio broadcast and verbal instruction with demonstration on tooth models. Personal explanation and thorough instruction would hardly have a place in this survey because it is outside the realm of generalized public educational procedure. It is urged that steps be taken at once to carry out this test of various toothbrushing methods so that the profession may come to the public with a method that has its unanimous approval and support. It is asked that these tests be so made that no unfairness will be evident, and that they be sufficiently scientific and comprehensive to satisfy the most reasonable doubter. This is an endeavor that might well be sponsored by the American Dental Association's Committee on Dental Health Education and aided by such groups as the American Academy of Periodontology, the American Society for the Promotion of Dentistry for Children, the various schools for dental hygienists and the directors of local and state mouth hygiene programs in various sections of the country. The American Academy of Periodontology might devise the rules, regulations and procedures under which these tests would be made, and the Dental Health Education Committee might tabulate and report the final results through THE JOURNAL.

I question the desirability of advocating one brushing method for children and another for adults. One method for both would be much easier to sell to the public. Also, we doubt the advisability of advocating one method for normal mouths and another for mouths showing disease. This paves the way for self-selection of methods and self-diagnosis, which are the very thing that we wish to overcome. We must have the public realize that it must depend on the dental practitioner for the diagnosis and advice which is beyond the limited information that we can give under public educational handicaps. Common-sense handling of this one important problem of public education will go far to remove some of the clutter now resting on the doorstep of public health dentistry.

TOOTH NEWS

DENTAL DIVISION NORTH CAROLINA STATE BOARD OF HEALTH

ANNOUNCEMEMT EXTRAORDINARY

ONE OF THE GREATEST FORWARD MOVEMENTS IN HEALTH EDUCATION IS ABOUT TO BE UNDERTAKEN

Members Of The North Carolina Dental Society Will Undertake To Examine The Mouths Of Two Hundred Thousand Children In The Schools Of The State Within One Week's Time.

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This Mouth Health Survey is a part of an intensive and extensive educational program for the benefit of the child and the child's parents. There are thousands and thousands of children who are members of the best families in our state whose mouths are in deplorable condition. An unclean mouth is an unhealthy mouth. A neglected mouth soon becomes filled with decayed and abscessed teeth. These are sources of infection and oftimes are the causes of kidney and heart diseases.

This Survey is in cooperation with the Division of Oral Hygiene of the State Board of Health, and has the undivided support of Dr. James M. Parrott, State Health Officer, Dr. A. T. Allen, State Superintendent of Public Instruction, and Mr. LeRoy Martin, Executive Secretary of the State School Commission, as well as the county superintendents, principals, teachers, and Parent-Teacher associations.

The state as a whole is under the direction of the State Director, five District Directors, and a County Director for each of the counties. The dentists are giving their time without financial remuneration in order that the survey may be complete and a true cross-section of actual mouth conditions may be revealed within our state. The parents of the children examined will be notified if the child is in need of dental attention.

We are taking the liberty of publishing three letters in order that you may have an idea of the enthusiastic reception that the Mouth Health Program is receiving from school officials as well as the pledging of cooperation on the part of the dentists. Our mails are full of letters such as these and we wish, of course, that it were possible to publish more of them.

Marion, N. C.
December 15, 1933

Dear Doctor Branch:

The making of a Mouth Health Survey, especially of school children is one of vital importance and should receive the cooperation of every parent in the State, as well as the support of the entire Dental Profession.

This is to inform you that I personally am 100% behind your program and I want you to feel free to call on me at any time for any service that I may be able to render.

With best wishes for the success of this Survey Campaign, I remain

Very truly yours,

B. A. Dickson, D. D. S.

Concord, N. C.
December 12, 1933

Dear Doctor Branch:-

I have your letter of December 7th, in which you state the North Carolina Dental Society will make a survey of the teeth of our school children. This is about the best news I have heard in a long time.

I wish to assure you that the School greatly appreciates this fine piece of work. We shall be glad to cooperate with you in any way possible.

Thanking you, I am

Yours cordially,

A. S. Webb,
Superintending Principal
Concord Public Schools

Mocksville, N. C.
December 12, 1933

Dear Doctor Branch:

I just want to send you my congratulations, and assure you of my appreciation of the service you are rendering the school children of the state in securing a thorough survey of the Mouth Health condition of all the children in North Carolina. I am interested in the same things you are interested in when it comes to a matter of this kind and will always be ready to support you in every way I can.

With strongest personal regards, I am

Cordially yours,

W. F. Robinson,
County Superintendent
of Public Instruction

The Mouth Health Survey, as planned in the schools will be made as far as possible on the same day in every school, as we expect about 700 dentists, who are members of the N. C. Dental Society to make the Survey. It will require very little time away from studies on the part of the children and should not interfere with the regular school program. This survey will be made during February.

December 1933
Trad.

AMERICAN PUBLIC HEALTH ASSOCIATION HEALTH EDUCATION INSTITUTE

Representatives of dentistry were conspicuous by their absence at the 1933 annual meeting of the American Public Health Association held last fall in Indianapolis.

It is to be regretted that but six dentists and two dental hygienists attended this meeting. Preventive dentistry is such an important factor in personal and community health that our profession should take a greater interest in the American Public Health Association affairs.

The Health Education Institute, under Dr. Galdston's leadership, was a most successful feature of the program. A two and a half day program on the "Psychology of Health Education" held the attention of the more than seventy members who attended.

Iago Galdston, H. E. Kleinschmidt and Mr. Bertrand Brown conducted the classes. They graphically discussed the "Psychology of Health Education"; its application to mass education, and its utilization in the written and spoken word.

The following outline of the course gives some idea of the subjects covered:

a. Why the psychology of health education?

b. The psychologic nature of the recipient of health education.

c. Fundamental principles relative to:
   1. Arresting attention
   2. Enlisting sympathy
   3. Imparting information

d. Meaning and mechanism of motivation.

e. Practical demonstrations; the application of the outline of psychologic principles to health education instruments; the spoken text, the printed text and graphic material.

This fall, the American Public Health Association meeting will be held in California and, because of its popularity, the Health Education Institute no doubt will be repeated. Dentists on the Pacific coast, particularly those interested in dental health education, are urged to attend. Nowhere can one secure in two days' time such a wealth of educational facts as are presented at the American Public Health Association Health Educational Institute.

NUTRITION IN NATIONAL EMERGENCIES

An editorial appearing in the January 7 issue of the *Journal of the American Medical Association* focuses attention on the value of an adequate diet during the present depression.

"Some time ago the British Medical Association appointed a committee on nutrition which has recently published its report. . . . This Committee, after careful consideration, recommended the adoption of the figure 3,400 calories in the food as the unit requirement of the normal man of average stature if health and working capacity are to be maintained. This is not regarded as a minimum figure, nor would the adoption of a bare subsistence standard fulfil the terms that both health and working capacity are to be maintained. It moreover does allow a little latitude for individual variation.

"The British experts have taken a noteworthy stand with respect to the protein factor in nutrition. Thus, they state,

" 'It is now usual to differentiate the protein foodstuffs into two classes. Proteins from animal sources are designated as first-class proteins, whilst those of vegetable origin are relegated to the second class. The first-class proteins, besides possessing higher nutritional value than second-class proteins, are more nearly completely absorbed by the body. Vegetable proteins are absorbed in varying proportions, which rarely exceed 80 per cent. There is a measure of agreement that from 10 to 15 per cent of the daily calories should be derived from protein, and 100 grams of protein per day will provide 12 per cent of the total daily calory supply of 3,400. . . . The Committee . . . agrees that 50 grams of first-class protein per day is sufficient to maintain the health and working capacity of the average man. The figure of 50 grams of first-class protein represents half the daily protein intake. The other half can be furnished from vegetable sources.'

"This conclusion will scarcely please the advocates of the exclusive vegetarian diet, though it will not affect those who practice the more common forms of lacto-vegetarianism.

"The new report alleges that a common fault in the dietaries of young children is a shortage of first-class protein. It insists that the popular prejudice against giving meat and cheese to children of this age is not based on physiologic data. In Britain, as in this country, the general consensus on the value of milk as a food for young children is so strong that it should be included in every case in the diet of children in order to maintain health and

normal growth. The American tendency would be, however, to exceed somewhat the guiding rule of 1 pint of milk a day for a child up to the age of 5, and of half a pint of milk from 5 years to 10. The usual stress is placed on the invariable inclusion of dairy produce, fruits and green vegetables in the family diet in order to ensure a sufficiency of food containing vitamins and mineral constituents. In view of rapidly changing purchasing values, it is almost futile to compare the proposed costs of adequate nutrition in times of stress. It is heartening, however, to find such general agreement among the English-speaking nations in respect to the fundamental food problems of their people."

"A NEW RAMIFICATION OF THE DENTAL HEALTH PROJECT"

"A New Ramification of the Dental Health Problem" by John Oppie McCall, appeared in the December, 1933, *Journal of the American Public Health Association*. This article gives some pertinent facts pertaining to the prevalence of caries in the teeth of New York children. The statistics given were obtained by the Guggenheim Dental Clinic of which Dr. McCall is director.

Quoting from the *Journal of the American Public Health Association:* "The Murray and Leonie Guggenheim Dental Clinic began operation in its present building September 14, 1931. Up to October 7, 1933, 10,147 children have been received there as patients. The usual age of admission for new patients is from 2 to 10 years. There have been a few admissions over this age limit. Since all children in the clinic district who are financially eligible are received, the findings may be accepted as constituting a cross-section of the dental condition of the preschool and school population of Greater New York. Of these children only 230 were free from caries; this means that 97.7 per cent had one or more cavities of decay.

"While these figures are higher than those usually given as the result of school surveys, they will not occasion surprise, at least to dentists. What may cause both surprise and concern to dentists and to all others interested in health matters is the way in which the percentages mount, beginning at an age well below that of school entrance. In other words, caries is found to be practically universal among children *of school age* in New York City.

"The following figures for preschool children are tabulated on yearly levels.

CARIES IN PRESCHOOL CHILDREN

2 years—32 patients
- 56% have cavities
  - 35% have 1-6 cavities
  - 21% have 7 or more cavities
  - Largest number of cavities in one patient—17

3 years—168 patients
- 83% have cavities
  - 43% have 1-6 cavities
  - 40% have 7 or more cavities
  - Largest number of cavities in one patient—20

4 years—425 patients
- 91% have cavities
  - 36% have 1-6 cavities
  - 55% have 7 or more cavities
  - Largest number of cavities in one patient—31

"With increase in incidence of caries and number of cavities goes, naturally enough, increase in their size and probability of pulp involvement with its sequel of dental abscess. An alarming number of children entering kindergarten are found to have many unsavable teeth and to be in need of time consuming operations on those that are savable. It seems fairly obvious, then, that both health and economic considerations demand the setting up of machinery for the registration of all preschool children and the institution of systematic dental care for them. The age of 2 would seem to be the logical age at which to start this program."

WOODROW WILSON GIRLS ATTAIN 100 PER CENT DENTAL HEALTH FOR TENTH CONSECUTIVE YEAR

The girls in the Woodrow Wilson Junior High School, Cedar Rapids, Iowa, have reached the 100 per cent goal in good teeth.

Directed by Miss Henrietta Frank, their physical education teacher, these girls have attained national prominence because of their achievement. Each year, as their dental health goal is reached, they wire the President of the United States of their success and each year they receive a congratulatory message in return. No other school in the United States can boast of such a record. These girls have established a tradition. It is unlikely that oncoming classes will break it.

Miss Frank, her pupils and their parents are to be congratulated for their efforts. Their ten year achievement should serve as an example to every school in America of what can be done in mouth health education. Let us congratulate them on their continued success.

THE NEW "CARE OF THE TEETH" BOOKLET MEETS WITH FAVOR

Several of the dental societies in various sections of the country have ordered the new booklet "Care of the Teeth" in large quantities. The Chicago Dental Society has ordered several thousand to distribute this coming year in connection with their new industrial dental diagnostic service and an order for 1,000 of these booklets has just been received from the Cedar Rapids (Iowa) Dental Association. It is suggested that the members of the various component societies pool their orders for these booklets, thus taking advantage of the lower rates. The December issue of THE JOURNAL (page 2267) gives details regarding this booklet.

A PRACTICAL TOOTHBRUSHING CHART FOR LAY EDUCATION

The chart shown below (18 by 28 inches) demonstrates a practical toothbrushing method for children and adults. It is printed on heavy paper and securely tinned at top and bottom. Developed by David B. Hill of Salem, Ore., it supplies a long felt want for use in schools, dispensaries and private offices.

Order your copy now. Price, 50 cents each.

Address Bureau of Public Relations, American Dental Association, 212 E. Superior St.

PRACTICAL TOOTH BRUSHING AND HABIT FORMING CHART

There are only four parts of every tooth to brush: top, outside, inside, and in between. Study the pictures. A tooth brush will not clean where it does not touch. Use a good tooth brush and a good dental cream or powder. Drink milk; eat leafy vegetables and fruit. Play outside each day; sleep at least ten hours.

1 First thing in the morning and last thing at night, brush teeth. Stand before mirror.

2 Put tooth paste on brush. Brush teeth at least two minutes. Time yourself.

3 Scrub hard two lower and upper biting surfaces. Count 20 each surface.

4 Brush outside of all upper teeth from gums down. Right side, left side and front.

5 Brush outside of all lower teeth from gums up. Right side, left side and front.

6 Brush inside of upper back teeth from gums down. Right and left.

7 Brush inside of lower back teeth from gums up. Right and left.

8 Brush the upper front teeth on inside from gums down.

9 Brush the lower front teeth on inside from gums up.

2 Well cared for teeth; a pleasant smile and face for life.

10 Brush the whole mouth for cleansing and stimulating effect; gums toward the teeth; cheeks and tongue.

11 Take water in mouth and rinse thoroughly with paste suds. Force hard between teeth. Count twenty.

NOTE—*Stick this on mirror.*

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NEWS

ALABAMA

Dentist Victim of Accidental Shot: Accidentally shot while on a hunting trip with friends, Riley Hill, aged 26, of Andalusia, graduate of Alabama Polytechnic Institute and Southern Dental College, Atlanta, died recently at a hospital in Andalusia. Dr. Hill was the only son of Dr. and Mrs. J. C. Hill, of Andalusia.

Death of Dr. Fowlkes: Benjamin Cobb Fowlkes, Selma, died, December 21; aged 56, after four years of invalidism following a stroke of paralysis. Dr. Fowlkes was educated in the Selma schools, Vanderbilt University, the University of Maryland, where he received his dental degree, and the Louisville Dental College, where he took special work in dentistry. He practiced in Mobile for some time before settling in Selma. Dr. Fowlkes is survived by Mrs. Fowlkes, two sons and one daughter, a third son having died three years ago.

CALIFORNIA

Part-Pay Clinic: San Diego's Central Clinic Service established last January by the San Diego County Medical Society was among the first of its kind in the United States. Its service has been so satisfactory that it has not only fulfilled the expectation of its creators but has also been a means of answering the widespread and continuing threat of state medicine. Physicians have scheduled a very low minimum charge for surgical and medical services. The clinic secretary fixes the fee to the applicant at a point somewhere between this very low fee and the average fee usually charged for the service required, basing the patient's fee on his capacity to pay. This is done after a careful examination by the clinic's field secretary. The oral health committee formulated a dental plan and canvassed the entire society. Of eighty-six members, thirty-nine have signified their willingness to accept dental patients from the Central Clinic Service.

Death of Dr. Dalrymple: William Gould Dalrymple, Los Angeles, died November 11, at the age of 68, after an illness of several months. He was born in Illinois, educated in the schools of Wisconsin and received his dental training in the Chicago College of Dental Surgery, graduating with the class of 1888. He practiced in Ogden, Utah, for thirty-five years, serving as the state society president for three years and on the state board of dental examiners, as president, for nineteen years. He removed to San Francisco in 1922 and to Los Angeles in 1928. We was a member of Delta Sigma Delta. The widow, a son, a daughter and a grandson survive.

FLORIDA

Resolutions Bearing on Economic Situation: The following resolution was passed by the Florida State Dental Society, Oct. 28, 1933:

WHEREAS, President Franklin D. Roosevelt has proclaimed there exists an economic emergency in the United States, and

WHEREAS, the Federal Government has appropriated huge sums of money for relief to the unemployed and further proposes that the unemployed shall have emergency dental services, and

WHEREAS, Mr. Marcus Fagg has requested in writing that the Florida State Dental Society submit to him a schedule of minimum fees to be paid for emergency dental relief services to the unemployed, and

WHEREAS, the Florida State Dental Society believes that this emergency calls on the professions and citizenry alike for sacrifice and cooperation, and

WHEREAS, the Florida State Dental Society now goes on record as being opposed to the manifestation of the attitude of getting, so to speak, "What is coming to it" from any Federal Funds which may be made available for emergency dental services, and

WHEREAS, the members of the Florida State Dental Society have rendered emergency dental services to the unemployed without compensation and seek to do so in the future as far as it is possible, and

WHEREAS, it may be possible that many members of the Florida State Dental Society are not financially able to render further emergency dental service to the unemployed without some compensation, if such is to be made available, and

WHEREAS, a schedule of fees for emergency dental relief has been set up by the Veterans' Administration of the United States Public Health Service; therefore, be it

Resolved, that the Florida State Dental Society declare the meaning of dental emergency relief service shall include (1) the relief of pain; (2) the removal of diseased conditions; and

Resolved, that the members of the Florida State Dental Society continue to render as far as is possible without compensation, emergency dental relief to the unemployed, and

Resolved, that any member of the Florida State Dental Society who conscientiously believes he is unable financially to render such emergency dental services may accept, in this situation of emergency from the Florida Emergency Relief Administration and its component local councils, fees equal to those already set by the Veterans' Administration and the United States Public Health Service for such services; and be it further

Resolved, that a copy of these resolutions be sent President Franklin D. Roosevelt and Mr. Marcus Fagg and that they become a part of the records of this society.

ILLINOIS

Death of Dr. Kirby: John L. Kirby, Chicago, died December 19; aged 60. He was graduated from the Kansas City Dental College in 1901. The widow and two sons, John D., of Dallas, Texas, and Wallace N. Kirby, D.D.S., of Downers Grove, Ill., survive him.

Death of Dr. Fredericks: Enoch M. Fredericks, Chicago, died recently; aged 65.

INDIANA

Indiana State Dental Association Adds Department of Dental Health: Plans to follow up the state-wide dental examination of school children with the full time services of a dental health worker were consummated in the appointment of Mary Westfall, D.D.S., who assumed her duties on November 15. While her work will carry her to all parts of the state she will retain central headquarters and may be reached by addressing "Good Teeth Council for Children," 808 Odd Fellows Bldg., Indianapolis, Indiana.

IOWA

Iowa Plan for Dental Health Education: In 1927, the Iowa Plan was introduced in the state and eleven counties and fifty-eight towns adopted the program. During the 1931-1933 school year, eighty-three counties and 464 towns ordered supplies and were "carrying on." Owing to economic conditions, these figures have dropped off slightly, but last year eighty counties and 418 towns were still active in carrying out the plan. The Iowa Plan is primarily educational in nature and as such is carried on through the schools of the state.

Keokuk Dentists Organize: Nine Keokuk county dentists held a meeting in Sigourney, November 22, and formed a county organization for the purpose of study. G. P. Baughman of What Cheer was elected president of the organization and R. D. Kelly of Sigourney, secretary and treasurer.

MASSACHUSETTS

Dr. Kazanjian on Lecture Course: V. H. Kazanjian will present one lecture in a series of twelve medical lectures at the Harvard Medical School, February 25, on "Dentistry's Contribution to the Repair of Face and Jaw Deformities."

MICHIGAN

Dean Resigns to Enter Priesthood: The University of Detroit authorities announce that Dr. William E. Cummer, dean of the School of Dentistry, has tendered his resignation in order to fulfil a desire of years to become a priest. He expects to enter the novitiate of the Basilian Fathers in Toronto, Canada, beginning a five-year course of study leading to Holy Orders. A convert to the Catholic Church in 1917, Dr. Cummer, after the death of his wife, determined to pursue the sacred studies of the Church, and to become a priest if possible. Entering this new field at the age of fifty-three, Dean Cummer carries with him wishes of success from a large host of friends and especially from his colleagues at the University.—*Apollonian,* October, 1933.

NEBRASKA

Three Living Deans in State: Nebraska has three living deans of dental colleges, all of whom have contributed to the development of the profession in the state. They are: Alfred Onian Hunt, Wallace Clyde Davis and George Albert Grubb.

NEW YORK

Dr. Wherry Honored: A. C. Wherry, President of the American Dental Association, was the guest of honor at a group alumni association luncheon, December 6, which was Branch Society Day of the Ninth Annual Greater New York Meeting.

Dr. Wynn Retires: Shirley W. Wynn, commissioner of health of New York City since 1928, retired December 31.

Prize Essays for Centennial of Organized

Dental Profession: The Centennial Comission of the First and Second District Dental Societies of the State of New York announces the following awards for suitable essays, at the discretion of the Prize Committee: A series of suitably engraved Centennial medals to each individual submitting the most acceptable paper embodying the result of original research or study not previously published and between 2,000 and 5,000 words in length. In addition to the medals, the papers are eligible for: 1. The 1934 "Morris L. Chaim Prize" of the First District Dental Society of $250, offered for the most acceptable essay not previously published on research in dentistry or any of its specialties. The essay may also deal with the fundamental sciences provided the work has a definite bearing on some dental problem. 2. The 1934 "Benjamin Lord Prize" of the First District Dental Society of $150 in the field of clinical dentistry, having an immediate and direct value to practical needs. 3. The "Frank T. Van Woert Prize" of the Second District Dental Society, of $100 for the best paper on "Dental History." 4. The "Thaddeus P. Hyatt Prize" of the second District Dental Society of $100 for the best paper on "Preventive Dentistry." The manuscript of the winning papers or others selected and any accompanying photographs, drawing charts, etc., will become the property of the Commission. The conditions under which these contests are to be conducted are stated in the January issue of the *New York Journal of Dentistry.* Further information may be obtained by addressing the Centennial Dental Commission, Academy of Medicine, 2 East 103d St., New York City.

Death of Dr. Cuinet: L. Adele Cuinet, one of the first women to enter the profession of dentistry, died, November 21, at her home in Brooklyn, after a long illness; aged 79. She was graduated from the Pennsylvania College of Dental Surgery in 1883 and later received a degree in law from New York University. In addition to her professional activities, Dr. Cuinet was interested in political and social welfare problems. In 1930, under the sponsorship of the Y. W. C. A., she made a survey of the narcotic traffic in China.

Death of Dr. Franken: Sigmund W. A. Franken, New York City, died December 13; aged 45. Dr. Franken was a graduate of the New York College of Dentistry, class of 1909. He was a member of the staff of the Lenox Hill Hospital, and had written extensively on dental service in hospitals, dental internships and plans for hospitals. He was a member of Delta Sigma Delta Fraternity.

OHIO

Dr. Brown Resigns: In view of the exacting duties incumbent on him, as Chairman of the Committee on Legislation and Correlation of the American Dental Association, Homer C. Brown has resigned from the Committee on Legislation and Dental Education of the Ohio State Dental Society.

OKLAHOMA

Death of Dr. Day: Charles W. Day, Tulsa, died January 2. He was a graduate of the Kansas City Dental College, class of 1892, and had been a member of the profession in Indian Territory and Oklahoma, being one of the organizers of the former state's dental society and a past president of the Oklahoma State Dental Society. Dr. Day was affiliated with Delta Sigma Delta.

OREGON

Dr. Dillard Receives Appointment: L. A. Dillard, of Roseburg, has been appointed consulting dentist for the Northwestern National Soldiers' Home.

Marion-Polk-Yamhill Society Meets: The regular monthly meeting of the Marion-Polk-Yamhill Dental Society was held on November 3 at the Spa. E. L. Brunk, of Salem, presided over the meeting. The program was in charge of George Lewis, also of Salem.

PENNSYLVANIA

Death of Dr. Faught: L. Ashley Faught, Philadelphia, died recently, at the age of 76, after fifty-six years service to the profession of dentistry. Dr. Faught retired from practice in 1924 to give his full time to the teaching of operative dentistry in the School of Dentistry of Temple University. He had contributed widely to the literature of the profession and at the time of his death had just completed an illustrated work on operative dentistry.

WEST VIRGINIA

Death of Dr. Epling: G. T. Epling, Welch, director of the McDowell Dental Clinic since its establishment in 1919, died, November 16, of uremia, at the age of 60.

WISCONSIN

Conference of Society Officers: The annual Conference of the Component and State Society Officers was held at the Hotel Loraine, Madison, December 10.

FOREIGN

Grant for Work of Hygiene Council: At the last annual meeting of the Canadian Life

Insurance Officers Association, held in Toronto, Nov. 17, 1933, a grant of $8,000 was made for the year 1933-1934 to the Canadian Dental Hygiene Council.—*Oral Health,* December, 1933.

Professor Ottesen Resigns: Prof. Imm. Ottesen, dean of the Norwegian Dental School since 1924, retired from office June 1, 1933. The new Dean is Prof. Dr. Guttorm Toverud.

Requirements for Candidates for Dental Degrees in British Isles: In England, Scotland, Wales and Northern Ireland, a candidate for the diploma licentiate in dental surgery (as differentiated from a university degree) must either register with the General Medical Council by showing that he has passed an examination in general education in accordance with their standards, and in addition an examination in elementary physics and chemistry, or he must matriculate in a university as a candidate for the degree B.D.S. (or B.D.Sc.) whose degree is a registrable qualification (in which latter event he is not required to register). The examination requirement may be met by passing the examination of a British or colonial university or one of the other accepted examinations listed by the General Medical Council. A typical matriculation examination (University of Manchester) includes the following subjects: 1. English Composition and Literature, or English Composition and History. 2. Mathematics. 3. Latin. 4. Mechanics. 5. One of the following: I. English Literature. II. History. III. Geography (Physical, Political and Commercial). IV. Greek. V. French. VI. German. VII. Some other language approved by the Joint Matriculation Board. VIII. Chemistry. IX. Either Natural History (Plants and Animals) or Botany. Examinations accepted by the General Medical Council vary somewhat in character, but the above may be taken as illustrative. A candidate for the degree course in an English or Irish university (none are offered in universities in Scotland) must pursue a five-year course after matriculation, and in his first year he takes physics, chemistry and usually biology (though sometimes this comes later), in the university; whereas a candidate for a licentiate diploma must take the premedical examination in chemistry and physics before becoming registered as a dental student and beginning his professional course. All of these preprofessional qualifications may be taken as fully equal to high school graduation in America. Students so qualified are usually better prepared in English history, mathematics and language than our own high school graduates, but not in the sciences until they have passed the premedical examination. A degree candidate who has completed his first year is fully up to the standard of an American student who has completed a one-year predental course.

Australia: In Australia, the requirements for beginning the study of dentistry are in general accord with those prevailing in Great Britain. In the State of Victoria, where Melbourne University is situated, the standard matriculation examination admits to the university. For the degree bachelor of dental science, the curriculum (coming into effect in 1930) is five years, in the first of which courses in chemistry, metallurgy, natural philosophy and zoology are comparable to those in our first predental year, and they have in addition prosthetic dentistry. In Sydney University of New South Wales, the dental course is now four years, which must be preceded by the university matriculation, and the higher arts examination which includes English, Latin, French, chemistry and physics, and requires one year's preparation.

The University of Adelaide at Adelaide, and that of Western Australia at Perth, both have dental schools conferring the B.D.S. degree. University matriculation is the admission standard.

New Zealand: The University of New Zealand is composed of four colleges situated in Dunedin, Christchurch, Welling and Aukland. That situated in Dunedin is called the University of Otago, and is the only one in which the dental course complete may be obtained. It offers two dental courses: one qualifying the student for a certificate of proficiency which covers four years, the other leading to the degree of B.D.S. and requiring four and one-half years. Both certificate and diploma are awarded by the senate of the university and confer the right to practice in New Zealand. For the certificate course, the usual matriculation as for an arts and science course is required, but for the degree a dental preliminary examination which includes a pass in science is demanded. A typical examination of this type would be: 1. English. 2. Mathematics. 3. Foreign language (French or Latin). 4. Science subjects such as chemistry or physics. 5. Optional subject as history or geography. 6. Extra subject. Physics, chemistry and biology of full college grade are included in the first two professional years of the degree course.

CURRENT LITERATURE

Some Useful Prescriptions for the Dental Profession (A. O. Mickelsen, J. Am. Pharm. A., November, 1933): Dean Mickelsen mentions the efforts made to maintain and advance professional pharmacy by education and research; also the fact that the compounding of useful prescriptions and formulas must be maintained to strengthen the professional status. Physicians and dentists may write original prescriptions now and then, but only systematic training, constant efforts and detailing the physicians and dentist can maintain pharmacy as a profession. Modern dentistry has brought to light a need for the professional services of the pharmacist that should not be overlooked. The author urges a closer relationship between physician, dentist and pharmacist. He gives two formulas for hand lotions, two for mouth washes, one for a neutral antiseptic powder, an alkaline antiseptic powder, an acid astringent antiseptic powder, a tooth powder, compound acetphenetidin capsules and a dental polishing paste.

T.

Present Day Problems in Economics (T. G. Hall, D. J. Australia, November, 1933): Dr. Hall scans the world chaos in economics and sums up the professional situation in a sentence, "He (the dentist) is not receiving payment for his work." He asserts that a man can conduct his practice with a minimum of expenditure, but unless he is paid in full the minimum charges, he cannot go on, and adds, "I know no other profession which has been so careless in the education of its clients. If we survive, something drastic must be done soon." Hall concedes the distastefulness of his suggestion but sees relief no where else. He gives illustrations of his remedy of *no credit,* then says, "A patient comes to you on your own terms and will fall in with your method whether he likes it at first or not. Patients exploit us on our own terms and we have been foolish enough to allow it." He scouts the idea that this is unprofessional, believing that it is a matter of educating the patient. Instead of the usual procedure, he suggests that the dentist determine the cost of conducting his practice and to that add 75 per cent and charge accordingly. An honest man, he believes, does not resent being asked for cash, and there is no sentiment in business. By getting one's dues, one can give where it is deserved. He sums the cost of billing from month to month in money, stationery and time and adds the collector's fees. Fifty per cent of the bill is gone. No credit eliminates the costs named. Books are up to date. No credit means no worry, no outstanding money; the dentist is paid for what he has earned.

T.

Control of Overhead Costs (E. F. Deck, D. J. Australia, November, 1933): We must be thrifty by nature and training: this is the author's primary hypothesis. He discusses possible economics under:

1. Space, which is to be subdivided, utilized and rented out. 2. Elimination of waste, covering unnecessary use or waste of gas, electricity; plaster, artificial stone, by weighing, or measuring according to need the wax and rubber used. 3. Chairside economics in the use of cements and amalgams. (One bottle of liquid should balance two of powder.) 4. Burs. Dull burs are reformed by stone for other purposes than cutting teeth. 5. Elimination of bitewing films when not absolutely necessary. 6. Laundry: The use of paper on head rests or in lieu of towels when possible. Soap should not be allowed to become water-logged. 7. Purchase whatever possible in quantity lots. 8. Use of a "Jack of all trades" ability to fill spare time in making repairs and substitutions. 9. Compounding office preparations such as formocresol, pulp-capping materials, desensitizing solutions and temporary fillings. Dr. Deck in no way encourages the use of old or worn-out equipment or discourages the use of the latest and best.

T.

Economies and Nationalization of Dentistry (G. A. M. Randle, D. J. Australia, November, 1933): Dr. Randle submits that dental economics in the profession will neither encourage nor retard nationalization of dentistry. It has nothing to do with the subject at all. Less has been said on the subject in England and on the continent than in America, yet in both

places it obtains, while in America it does not. The crux of the matter is the fact that "the moment the legislators believe the people will be served better by nationalization it will be brought to pass." Can the legislators be convinced that the profession is stamping out dental disease? Randle believes "we have failed miserably in our duty to the public." We boast of progress "from a humble level to that of a science during the last quarter of a century" and, on the other hand, dental disease has increased. This may cause legislators to nationalize dentistry. Randle speaks of the governmental care given cattle, pigs and sheep when disease shows among them, and suggests an approach to the government in behalf of the children—the people. He says the profession doing private dental work has failed; nationalization is also failing to eliminate the disease. To find the cause of dental disease is the government's duty. Dentists cannot do this and make a living, too; the government must aid. T.

FOREIGN LITERATURE

Treatment of Canals with Living Pulp (Bernhard Gottlieb, Balint Orban and Georg Stein, J. Dent. Belge, September-October, 1933): These authors have experimented on the work on root canals with dogs' teeth which they believe to be particularly well suited for the purpose. They present a therapeutic method for care when the pulp is entirely or partially alive. The first illustration is for cases of pulps which have been exposed as a sequel of traumatism. They distinguish between young teeth in which the foramen is still open and only recently closed and aged teeth. Their experiments have shown that pulverized dentin placed on the pulp joins the tissue of the neoformation secreted by the pulp into the interstices of the dust, thus closing the opening. This method is not always successful, for, in some cases, it produced a chronic inflammation. In only clinical cases which appear favorable should this treatment be given. The authors give their technic for this operation in detail. Removal of the root appears to be the method of choice as soon as the foramen is closed. The authors reject all methods of pulp removal using arsenic, cobalt and similar products because they believe the results are usually bad. They practice the removal of the pulp by surgical methods using local anesthesia. Again they give their technic in detail. They believe that the best results are obtained by filling the canal with cement mixed with powdered dentin. The article is accompanied by several illustrations which the authors discuss, showing further the results of their work both experimentally and clinically. T.

Rôle of the Woman Dentist in the Care of Children's Teeth (L. Guericolas, Rev. Odontol., October, 1933): The woman dentist should know certain things before undertaking the care of children's teeth. It is particularly essential to understand the psychology of the child. A child has a great deal of imagination and usually an extraordinary memory. He reasons and draws conclusions from single resemblances. On all of these qualities, the dentist should base her methods of procedure. Children have self-respect and pride. They like to impress their friends and their relatives with their courage. The dentist should appeal to these qualities. She should size up the little patient at his first visit to see how his parents have prepared him for the visit. If the child is brave, the dentist should be calm, smiling and patient. If he is frightened, the practitioner should first take steps to overcome this fear. The child's wait should be pleasant. There should be pictures and games to amuse him. He should get into the chair by himself. When he is very fearful, his mother may stay by his side, if her manner is calm and reassuring. The dentist should not start her actual work on the patient until his confidence is gained. The atmosphere in the office should be cheerful and interesting. It is well to explain the uses of the instruments and the advantages of the work to the patient's future health and welfare. As it may be seen, the child specialist in dentistry needs to be somewhat of a psychologist and a teacher.

T.

Rôle of the Subtrapezoid Lymph Nodes in Brachial Neuralgia of Dental Origin (Jean Veyrassat, Rev. Odontol., August, 1933): The author gives two case histories of patients who have suffered from the harmful action of focal infection as caused by the teeth. Both patients suffered from brachial neuralgia. On examination of the neck, the subtrapezoid lymph nodes were found to be inflamed. The first patient had three badly decayed teeth and the second had a decaying upper left third molar. Removal of these teeth gave both patients relief from their symptoms. The author points out the causative relationships in his cases. The caries causes the development of the cervical adenopathy, which, in turn, sets up powerful phenomena in the arm. The adenitis acts by direct pressure on the nerves with which

the area is in contact. The subtrapezoid lymph nodes have not drawn the attention of clinicians which they deserve. The interesting feature of these observations is that in adenitis of the spiral nerve chain, the trapezoid muscles have these symptoms set up in the brachial, plexus and the spinal nerve. These cervical lymph nodes are the ones which frequently provoke signs of compression. Since this clinical picture is of dental origin, it is important that the dentist make an immediate pathogenic diagnosis.

T.

Physical, Chemical and Biologic Action of Heat on the Tissues (Pierre Rolland, L'Odontologie, November, 1933): The author states that the subject under discussion is one of great antiquity. In the time of Hippocrates, heat was considered a valuable therapeutic agent. He then points out the physiologic difference between warm-blooded and cold-blooded animals. He shows this great adaptability of the human organism in conditions of extreme heat and cold. He reviews the physiologic principle involved in the human struggle against heat and cold. There are several degrees of heat to which the skin may be subjected. Beyond 50 degrees the alterations of the skin are those caused by a burn. Heat acts on the skin, on the circulation and on the respiration. "All of the reactions to heat constitute a hyperemia characterized by increased blood irrigation. The white blood cells, try diapedesis, come out of dilated capillaries and spread into the connective spaces. Diapedesis, then phagocytosis, these are the elements in the fight against infection. This very circulation, increased by heat, joined with hyperemia, favors leukocytosis and explains, in part, the analgesic action of heat. Exudates are absorbed, stagnant substances are drawn off, edema diminishes and the nutrition of tissues is stimulated." The analgesic action of heat has certain other unexplained elements, but whatever the explanation, the effect is real and the use of heat is justified in many disturbances. The methods of administering heat are given as (1) radiation at a distance, (2) contact with gases or vapors (dry or moist), (3) contact with liquids and (4) contact with solid bodies, such as poultices, compresses and hot-pads. Heat is sedative and analgesic (neuralgic, arthritis, rheumatism). It is anti-inflammatory (inflammations, phlegmons, suppurations). It is stimulating and tonic (ulcers, fractures and all disturbances where cicatrization is slow). Diathermy is an effective means of producing heat for use about the jaws. Likewise, warm air from syringe or from compressed air apparatus is invaluable in dental therapeutics. Ordinary poultices are not often used in dentistry because of the risk of spreading inflammation. This disadvantage is done away with by the use of poultices treated with glycerine. Glycerine creates an aseptic medium when bacteria cannot be cultivated. It purges the tissue of toxins by osmotic drainage.

T.

Contributions to the Histology of Giant Cell Tumors of the Jaws (H. Hammer, Vierteljahrsschr. f. Zahnheilk., 46: 505, 1930): The author agrees with the view of Lubarsch and others that the giant-cell tumors of the jaws are not true tumors but chronic inflammatory and resorptive formations. The giant cells are without doubt of endothelial origin. Injuries which prepare the bone for resorption may stimulate the endothelium to form resorptive tissue. Epulis is caused more frequently by marginal processes; while giant cell sarcomas are caused rather by apical processes. The epulis which contains giant cells and the central giant cell sarcoma belong without doubt to the group of osteodystrophia fibrosa.

I. S.

Effect of Infusorial Earth on the Jaws of Guinea-Pigs (W. Hartel, Vierteljahrsschr. f. Zahnheilk., 46:541, 1930): The view that epulis is produced by purely traumatic conditions cannot be confirmed by experiment. The structure of the epulis and its elements is different from that of foreign body granulomas. Foreign body giant cells are structurally and functionally alike in bone marrow connective tissue and subperiosteum. The so-called smooth resorption of bone is also conditioned by osteoclasts. In the material studied, there was no evidence of active participation of the bone in its resorption.

I. S.

Social Dental Care in the Scandinavian Countries (Arvid Arisholm, Norkske Tannlegefor. Tid., September, 1933): Denmark: The first attempt in the direction of public dental care was made about fifty years ago, in Copenhagen by the dentists themselves. Later, the dental organization requested the government to start advising that prophylactic and school dentistry was the basis on which to build. The first school clinic was established in 1910. Now school dental care is given in twenty-three counties (communities)

and in forty-three children's homes, but the state does not contribute toward these. In some hospitals, insane asylums and sanitariums and in the army, a dental care program is carried through. The most important part of social dental care is rendered by the sick benefit associations recognized by the state. In Denmark, there are 1,646 associations, to which 65 per cent of the population over the age of 15 belong. These associations, with help from the state to the extent of 25 per cent, take care of all types of dental ailments, each group having its own rules as to what extent dental services are to be rendered their members. Of the groups, 424 include conserving dental care. In most cases, the dentists treat the patient at their own offices. Three groups have their own dental clinic. The payments are arranged in two ways: 1. The association pays a yearly fee per individual and the patient pays a small fee when service is rendered. 2. The association and patient each pay half.

Sweden: As in Denmark, the dentists themselves were the first to propose and work out the plans for public dental care. A clinic for people unable to pay was established in Stockholm about 1884. The work on the school dental care started about 1900 and today every place of any importance has its school clinic. All state institutions, hospitals, asylums, etc., have dental clinics. There is no connection in Sweden between the sickness benefit associations and public dental care, and the state has no regulations about public dental care or contributions toward it. A state committee is working on the question now. Four experimental polyclinics have been established. In Stockholm, the very large clinics established by the dentists take care of poor people at reduced fees. This type of clinics have also been established in other towns.

E. G. J.

Changes in Normal and Pathologic Tooth Structure (H. Pfluger, Vierteljahrsschr. f. Zahnheilk., 1932, pp. 426-442; 1933, pp. 45-56): The dentin formation is influenced by the organizing effect of the enamel epithelium on the mesodermal structure of the tooth papilla. The author sees evidence of this in the fact that, in osteogenesis imperfecta, there is a disturbance in calcification of the dentin only and not of the enamel. The outer dentin zone is but slightly affected; the epithelium is not affected at all. Contradicting Port-Euler, the author believes that dentin formation precedes enamel formation. The author reports his experiments on coloring with uroporphein, which show that, in the erupting tooth, there is a flow of the coloring matter from the dentin into the enamel.

O. K.

Operative Treatment of Chronic Periapical Periodontitis and Its Results (H. Hammer, Deutsche Zahnarzl. Wchnschr., 1933, pp. 151-155): There are very few data in German literature on the success of operative root-canal therapy. Wassmund figures on 1 per cent failures; Walkhoff estimates the failures as between 10 and 20 per cent. The author followed up with recalls 573 cases treated at the University Institute of Berlin during the years 1925-1930. He found 96 per cent of the treated patients in excellent condition. Out of 151 cases, 139 showed perfect regeneration of periapical bone, and in seven cases, the healing processes were still going on. Only 4 per cent of cases of failures were definitely established. Those teeth were loose and fistulas were present.

O. K.

MISCELLANY

BOOK REVIEW

Crisis in Orthodontia. By Albin Oppenheim, Vienna, 1933; Urban & Schwarzenberg, Publishers.

In the first part of this brochure, the author reviews critically the individual work in orthodontia of Gottlieb, Orban and A. M. Schwartz. Gottlieb and Orban experimented on animals, mainly dogs, and they concluded that delicate constant force should be employed in orthodontic movement. The application of intermittent strong force in the movement of teeth brought about injuries and necrosis which ended in a "restitutis ad integrum," with a return to the normal function of a normal periodontium. The author, reviewing all the experiments of Gottlieb and Orban on orthodontia, comes to this conclusion: The overemphasized fear (of resorption of cementum) and advocacy of delicate constant force only is a result of ill-based conclusions from animal experimentation. These conclusions, he believes, have no right to be applied to human orthodontic treatment, and have no place in the practical science of orthodontia. The only significance for orthodontia from Gottlieb and Orban's investigations is that the strongest intermittent force is not able to cause a genuine root resorption. As to the work of Schwartz on structural changes in orthodontic procedures, the author accuses Schwartz of using "bombastic, theoretical foundations." He proves that Schwartz misinterprets the research of other investigators and believes that Schwartz erroneously builds up his "apical resorption theory" with the same material with which Gottlieb and Orban could not show a single case of resorption. Orthodontia is a science based upon practice. It often happens that it is necessary to withdraw and abandon ideas and theories which were once thought to be true on the basis of newly gained experience. Schwartz rejects fundamental questions in such a short time as from one to three months, and builds up arguments which he opposed but one day before, without giving himself time to prove his points. Such procedure, the author emphasizes, cannot shed enlightment on the subject, but contributes toward confusion.

OSCAR KARPF

THE REGISTRATION OF DENTISTS ENACTMENT—1933 FEDERATED MALAY STATES

By CARL H. BOEHRINGER, Acting Trade Commissioner, Singapore, Straits Settlements

The supplement to the "Federated Malay States Government Gazette" of September 22, 1933, the supplement being dated September 29, 1933, stated that a bill is about to be introduced into the F.M.S. Federal Council to provide for the privileges of dentists registered under "The Registration of Dentists Ordinance, 1933," of the Straits Settlements and for the disabilities of persons not so registered.

In an explanatory note entitled, "Objects and Reasons" it is pointed out that the Registration of Dentists Enactment, 1931, provides for the registration of dentists in the Federated Malay States and prohibits the practice of dentistry by any person not registered under that Enactment. The corresponding law in the Straits Settlements was Ordinance No. 202 (Dentists Registration) of 1924.

It is also pointed out that there has now been passed a new Ordinance in the Straits Settlements, the Registration of Dentists Ordinance of 1933, which establishes a common register of dentists in the Straits Settlements and in the Malay States under British protection.

The object of the present bill is to recognize as entitled to practice dentistry in the Federated Malay States all those dentists registered in the common register kept under the Straits Settlements ordinance, and so obviate the need to keep a separate register in the Federated Malay States. The system of registration of dentists will then be similar to the system which has always been employed in the case of medical practitioners.

If this bill is passed, it will be possible to allow the practice of dentistry by those persons who were practicing in the Federated Malay States prior to the Enactment of 1931,

but who cannot at present be admitted to the register kept under that Enactment owing to their failure to register within the period prescribed in Section 5 (iii) of that Enactment. It will also be possible for any registered dentists to practice either in the Colony or in the Federated Malay States; at present there is no reciprocity with the Colony in this respect.

The register of the Colony will be under the control of a Dental Board on which there will be two representatives from the Federated Malay States. The provisions of the Colony Ordinance in regard to original registration, annual retention on the register, and removal from the register, are similar to those in force under the present Enactment.

The various clauses of this bill vary from the corresponding sections of the present Enactment only to the extent of the alteration required to substitute recognition of registration in the Colony register for registration in the Federated Malay States. The bill proposes no other changes in the existing legislation.

The Straits Settlements ordinance was forwarded to the Bureau attached to a letter dated August 25, 1933, subject—"Ordinances Governing Registration of Doctors & Dentists"—referred to the Specialties Division. —Dept. of Commerce, Bureau of Foreign and Domestic Commerce.

CORRESPONDENCE

Misplaced or Impacted Teeth

To the Editor:

I should be grateful to any member of the American Dental Association who would assist me in gathering material for an article on misplaced and impacted teeth. The following data are desired: 1. Age of patient when misplaced or impacted teeth were discovered and the age when removed. 2. Effects, signs and symptoms, local, general or remote, which drew attention to the presence of these teeth. 3. Effects that removal had on the patient; i. e., disappearance of symptoms, effects, etc., improvement or otherwise. 4. Sex of patient. 5. Anesthetic employed in removal of tooth. 6. Position of the tooth, and any drawings, diagrams, roentgenograms, etc., available, showing the location of the tooth and any history of the case. Credit will be given for any material used, and if requested, return will be made of roentgeonograms, etc. Those contributing data in the form of prints, roentgenograms, etc., are asked to write name and address plainly thereon.

Alonzo M. Nodine, D.D.S., L.D.S.R.C.S., L.R.C.P., M.R.C.S.
117, The Ridgway, Wimbledon Common
London, S. W. 19
England

ANNOUNCEMENTS*

CALENDAR OF MEETINGS

American Dental Association, St. Paul, Minn., August 6-10.

American Dental Society of Europe, Holland, August.

American Public Health Association, Pasadena, Calif., September 3.

Chicago Dental Society Midwinter Clinic, February 26-March 1.

Five State Post Graduate Clinic, Washington, D. C., March 19-21.

International Congress of Radiology, Zurich, Switzerland, July 24-31.

Society for Advancement of General Anesthesia in Dentistry, New York City, third Monday in February, April, October and December.

Southern Academy of Periodontology, Atlanta, Ga., March 14.

Southern Society of Orthodontists, Hot Springs, Va., July 16-17.

Thomas P. Hinman Midwinter Clinic, Atlanta, Ga., March 12-13.

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

STATE SOCIETIES

March

Minnesota, at St. Paul (3-4) (Business meeting only)

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of The Journal.

April

Alabama, at Montgomery (23-25)
Connecticut, at New London (18-20)
Kentucky, at Louisville (9-11)
Michigan, at Grand Rapids (9-11)
Montana, at Missoula (12-14)
New Jersey, at Atlantic City (25-27)
Tennessee, at Chattanooga (26-28)
Texas, at Fort Worth (24-26)
Virginia, at Charlottesville (30-May 2)
Wisconsin, at Milwaukee (17-19)

May

Arkansas, at Little Rock (14-16)
Illinois, at Springfield (8-10)
Indiana, at Indianapolis (21-23)
Iowa, at Cedar Rapids (1-3)
Kansas, Missouri and Oklahoma (Tri-State) 6-9
Maryland, at Baltimore (7-9)
Massachusetts, at Boston (7-9)
Nebraska, at Lincoln (21-24)
New York, at Buffalo (9-12)
South Dakota, at Mitchell (14-15)
Vermont, at Burlington (16-18)
West Virginia, at Clarksburg (21-23)

June

Southern California, at Los Angeles (4-6)
Georgia, at Atlanta (11-13)
New Hampshire, at Lake Sunapee (27-28)
North Carolina, at Wrightsville Beach (18-20)
Washington, at Tacoma (14-16)

STATE BOARD OF DENTAL EXAMINERS

New Jersey, at Trenton, June 25-30. John C. Forsyth, Secretary, 148 W. State St., Trenton.

CHICAGO DENTAL SOCIETY MIDWINTER CLINIC

The seventieth annual Midwinter Clinic of the Chicago Dental Society will be held at the Stevens Hotel, February 26-March 1. The program will consist of essays and clinics, in many cases combined in such a way as to present not only theories but also the practical application thereof. The commercial exhibits will occupy the large exhibition hall of the Stevens. Fraternity functions will be held Monday night, February 26; annual frolic, Tuesday night and banquet and dance, Wednesday night. The Ladies' Entertainment Committee will sponsor a bridge luncheon and many informal functions for the women in attendance.

STANLEY D. TYLMAN, *Secretary*
185 N. Wabash Ave.
Chicago, Ill.

WISCONSIN STATE DENTAL ASSOCIATION

The annual meeting of the Wisconsin State Dental Association will be held at Milwaukee, April 17-19.

E. E. PARKINSON, *Secretary*
104 King St.
Madison.

PENNSYLVANIA STATE DENTAL ASSOCIATION

The Pennsylvania State Dental Association will meet May 1-3.

C. W. HAGAN, *Secretary*
1011 Macon Ave.
Pittsburgh.

CENTRAL PENNSYLVANIA DENTAL SOCIETY

The thirty-second annual meeting of the Central Pennsylvania Seventh District Dental Society will be held at the Penn Alto Hotel, Altoona, February 26-28.

H. L. WAGNER, *President*
Central Trust Bldg.
Altoona.

NEW JERSEY BOARD OF REGISTRATION

The State Board of Registration and Examination in Dentistry of New Jersey will hold its regular examinations in Trenton, commencing June 25 and continuing for five days thereafter. The examination fee is $25; reexamination, $10. Application must be filed complete ten days before the date of examination, June 15. Address all communications for further particulars to

JOHN C. FORSYTH, *Secretary*
148 West State St.
Trenton.

AMERICAN SOCIETY FOR THE ADVANCEMENT OF GENERAL ANESTHESIA IN DENTISTRY

The next meeting of the American Society for the Advancement of General Anesthesia in Dentistry will be held, March 26, at the Fraternity Clubs Bldg., 22 E. 38th St., New York City. Dinner at 7 and scientific meeting at 8:30 p.m. For reservations for dinner, address M. Hillel Feldman, 730 Fifth Ave., New York City.

HARRY J. FIELD, *Secretary*
130 Market St.
Newark, N. J.

ALUMNI ASSOCIATION OF WASHINGTON UNIVERSITY

The sixty-eight annual meeting of the alumni association of Washington University will be held February 21-22.

WALTER H. HESEMAN
2505 N. 15th St.
St. Louis, Mo.

VIRGINIA STATE DENTAL ASSOCIATION

The next meeting of the Virginia State Dental Association will be held at Charlottesville, April 30-May 2.

A. M. WASH, *Secretary*
Medical Arts Bldg.
Richmond.

SOUTHERN ACADEMY OF PERIODONTOLOGY

The Southern Academy of Periodontology will meet, March 14, at the Biltmore Hotel, Atlanta, Ga.

JAMES A. SINCLAIR, *Secretary*
Asheville, N. C.

KANSAS, MISSOURI AND OKLAHOMA TRI-STATE MEETING

The state dental associations of Kansas, Missouri and Oklahoma will hold their annual meetings jointly at the Ararat Temple, Kansas City, Mo., May 6-9. A diversified program has been arranged and a very extensive display of manufacturers' exhibits will be made.

FRED A. RICHMOND, *Chairman,*
Publicity Committee
Federal Reserve Bldg.
Kansas City, Kan.

MINNESOTA STATE DENTAL ASSOCIATION

Because the state of Minnesota is to act as host to the American Dental Association at the next Annual Session, the regular annual meeting of the Minnesota State Dental Association will not be held, but as there are matters of great importance to be considered by the organization, the regular business meeting will be held March 3-4.

L. M. CRUTTENDEN, *Secretary*
Hamm Bldg.
St. Paul.

SOUTHERN SOCIETY OF ORTHODONTISTS

The thirteenth annual meeting of the Southern Society of Orthodontists will be held at the Homestead, Hot Springs, Va., July 16-17.

WILLIAM R. WOOD, JR., *Secretary*
442 W. Lafayette St.
Tampa, Fla.

SWINDLER

Members of the profession are warned against a fraudulent alcohol salesman who has victimized several dentists in the vicinity of Elizabethton, Tenn. The swindler is about 40 or 45 years old, of medium height, with thin gray hair and, it is believed, false teeth. He dresses neatly and is a convincing talker. He claims to be a representative of the Ukiah Grape Products Co., Inc., New York City, selling grain alcohol, for which orders are taken and the money collected in advance. Inquiries addressed to the street number given in New York were returned, marked "Removed, left no address."

KINGS COUNTY DENTAL SOCIETY

The Midyear Meeting of the Kings County Dental Society will be held, February 15, at 8:30 p.m., at the Brooklyn Academy of Music, Ashland Place and Lafayette Ave. The evening will be devoted to a symposium on "Oral Manifestations of General Systemic Disease and Their Sequelae." Joseph Cold Bloodgood will present the medical side of the question and Lester R. Cahn, the dental side. Preceding the symposium, there will be a clinic presented by Dr. Bloodgood on "Neoplasms of the Oral Cavity." February 16 will be devoted to clinics and topic discussions. For further information, address

DAVID SLUTSKIN, *Chairman*
Educational Committee
62 Hanson Place
Brooklyn, N. Y.

DENTAL HYGIENISTS ASSOCIATION OF THE STATE OF NEW YORK

The fourteenth annual meeting of the Dental Hygienists Association of the State of New York will be held May 9-11, at the Hotel Statler, Buffalo.

MELVA E. DEROOS, *Chairman*
Publicity
122 E. Henrietta Road
Rochester, N. Y.

RECENT BOOKS WORTH BORROWING* OR BUYING†

from the

LIBRARY BUREAU

of the

AMERICAN DENTAL ASSOCIATION

212 E. Superior St., Chicago, Ill.

Adams, C. W.	Your teeth and their care. St. Louis, Mosby, 1932. $1.25. Alfred David Lenz system of lost wax casting. New York, National Sculpture Soc., 1933. $1.50.
American Pharmaceutical Assn.	Pharmaceutical recipe book. Baltimore, Md., American Pharmaceutical Assn., 1929. $5.00.
Anderson, G. M.	Orthodontic laboratory manual. St. Louis, Mosby, 1930. $2.00.
Anthony, L. P.	Dental terminology. Chicago, American Dental Assn., 1930. (Free.)
Appleton, J. L. T., Jr.	Bacterial infection with special reference to dental practice. Philadelphia, Lea & Febiger, 1925. $6.00.
Appleton, J. L. T., Jr., & Bryant, C. K.	Laboratory guide in bacteriology. Philadelphia, Lea & Febiger, 1928. $2.75.
Bartels, H. A.	Outline of bacteriology. New York, W. A. Broder, 1929. $2.00
Beck, Dorothy F.	Cost of equipping a dental office. Chicago, University of Chicago Press, 1932. $1.00.
Berger, Adolph	Principles and technique of oral surgery. Brooklyn, Dental Items of Interest Pub. Co., 1927. $7.00.
Berger, Adolph	Principles and technique of the removal of teeth. Brooklyn, Dental Items of Interest Pub. Co., 1929. $7.50.
Blunt, Katharine, & Cowan, Ruth	Ultraviolet light and vitamin D in nutrition. Chicago, University of Chicago Press, 1930. $2.50.
Bödecker, C. F.	Elementary histology for dental hygienists. New York, W. A. Broder, 1929. $2.00.
Bogert, L. J.	Nutrition and physical fitness. Philadelphia, Saunders, 1931. $3.00.
Bosworth, H. J.	Dental economics. Chicago, Bosworth Economic Institute, 1932. $10.00.
Bowler, Inez	Elementary manual of dental library practice. Ann Arbor, Univ. of Michigan Press, 1932.
Box, H. K.	Necrotic gingivitis. Toronto, University of Toronto Press, 1930. $1.00.
Box, H. K.	Treatment of the periodontal pocket. Toronto, University of Toronto Press, 1928. $1.00.
Bregstein, S. J.	Business conduct of an ethical practice. Brooklyn, Dental Items of Interest Pub. Co., 1932. $4.00.
Broderick, F. W.	Dental medicine. St. Louis, Mosby, 1928. $6.00.
Broderick, R. A.	Dental bacteriology. Outlines of dental science. Vol. 2. Edinburgh, Livingstone, 1926. $2.50.
Brothers, E. D.	Dental jurisprudence. St. Louis, Mosby, 1928. $2.25.

*Books may be *borrowed* by members of the Association for a period of one week after date of receipt; and if not reserved for some one else, the period will be extended on request. A deposit of $2.00 for each volume to be sent at one time should accompany all requests for books. This will be refunded on return of books.

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Brown, A. J.	Dental metallurgy. Outlines of dental science. Vol. 11. New York, Wood, 1928. $2.50.
Brown, W. L.	Endocrines in general medicine. St. Louis, Mosby, 1927. $3.00.
Buckley, J. P.	Modern dental materia medica, pharmacology and therapeutics. Philadelphia, Blakiston, 1926. $6.00.
Bulleid, Arthur	Textbook of bacteriology for dental students. St. Louis, Mosby, 1927. $4.50.
Bunce, E. W.	Bunce-Kanouse full denture technic. Chicago, Coe Laboratories, Inc. 1929. $1.25.
Bunting, R. W.	A textbook of oral pathology for students and practitioners of dentistry. Philadelphia, Lea & Febiger, 1929. $7.00.
Burchard, H. H., & Inglis, O. E.	Textbook of dental pathology and therapeutics for students and practitioners. Philadelphia, Lea & Febiger, 1926. $7.50.
Burkhart, H. J.	Care of the mouth and teeth. (National Health Series.) New York, Funk & Wagnalls, 1928. $0.30.
Buxton, J. L. D.	Dental pathology. Outlines of dental science. Vol. 7. New York, Wood, 1927. $2.50.
Buxton, J. L. D.	Dental surgery. Outlines of dental science. Vol. 8. New York, Wood, 1927. $2.50.
Cahn, L. R.	Basic principles of general and oral pathology. Brooklyn, N. Y., Dental Items of Interest Pub. Co., 1929. $4.50.
Campbell, Menzies	Those teeth of yours. London, Heinemann, 1931. $1.50.
Casto, T. D.	Questions and answers on pedodontology, with glossary. Philadelphia, Author, 1932. $2.50.
Cattell, Psyche	Dentition as a measure of maturity. Cambridge, Harvard University Press, 1928. $1.00.
Churchill, H. R.	Human odontography and histology. Philadelphia, Lea & Febiger, 1932. $4.50.
Clark, C. A.	Dental radiography. Outlines of dental science. Vol. 5. New York, Wood, 1926. $2.50.
Cogswell, W. W.	Dental oral surgery. Pittsburgh, Penna., Dental Digest, Inc., 1932. $10.00.
Colyer, J. F., & Sprawson, Evelyn	Dental surgery and pathology. New York, Longmans, 1931. $12.50.
Colyer, Stanley	Chronic infection of the jaws: a short radiological and clinical study. New York, Macmillan, 1926. $3.50.
Committee on Costs of Medical Care	Medical care for the American people. Chicago, Univ. of Chicago Press, 1932. $1.50.
Dall, William	Ground porcelain inlays. London, Henry Kimpton, 1933. $5.25.
Daukes, S. H.	Medical museum: Modern developments, organization and technical methods based on a new system of visual teaching. London, Wellcome Foundation, Ltd., n.d. (No purchase orders accepted.)
Davis, M. M.	Paying your sickness bills. Chicago, University of Chicago Press, 1931. $2.50.
Dental Board of the United Kingdom	Four lectures on "general anaesthesia." London, Dental Board of the United Kingdom, 1926. $2.00.
Dental Board of the United Kingdom	Three lectures on "dental alloys." Delivered under the auspices of the Dental Board of the United Kingdom. London, Dental Board of the United Kingdom, 1927. $2.00.
Diamond, M.	Dental anatomy. A graphic presentation of tooth forms with an original technique for their reproduction. New York, Macmillan, 1929. $3.50.
Dorrance, G. M.	Operative story of cleft palate. Philadelphia, Saunders, 1933. $6.50.
Doxtater, L. W.	Procedures in modern crown and bridge-work. Brooklyn, N. Y., Dental Items of Interest Pub. Co., 1931. $8.00.
Endleman, Julio	Special dental pathology; a treatise for students and practitioners. St. Louis, Mosby, 1927. $7.00.

Ennis, L. M.	Dental roentgenology. Philadelphia, Lea & Febiger, 1931. $6.50.
Farkasch, O.	Dilemmas of dentistry. New York, Dodd Bros., 1931. $3.50.
Federspiel, M. N.	Harelip and cleft palate. St. Louis, Mosby, 1927. $5.00.
Felcher, F. R.	Art of porcelain in dentistry. St. Louis, Mosby, 1932. $9.00.
Feldman, M. H.	Manual of exodontia. Philadelphia, Lea & Febiger, 1930. $3.50.
Ferguson, H. W.	Child's book of the teeth. Yonkers-on-Hudson, World Book Co., 1932. $0.68.
Fine, Samuel	Principles and practice of dental assistant. Worcester, Mass., Hamilton Pub. Co., 1931. $2.50.
Fischer, Guido	Local anesthesia in dentistry. Philadelphia, Lea & Febiger, 1933. $4.00.
Fish, E. W.	Experimental investigation of enamel, dentine and the dental pulp. London, John Bale, Sons & Danielsson, Ltd., 1933.
Fish, E. W.	Principles of full denture prosthesis. London, John Bale, 1933. $4.00.
Fones, A. C.	Mouth hygiene; a textbook for dental hygienists. Philadelphia, Lea & Febiger, 1927. $5.00.
Fones, A. C.	Preventive dentistry. Philadelphia, Lea & Febiger, 1925. $2.75.
Foote, J. S.	Bone as a measure of development: When and how we acquired our teeth. Chicago, American Dental Association, 1928. $4.00.
Franzen, Raymond	Public health aspects of dental decay in children. New York, American Child Health Assn., 1930. $1.25.
Gies, W. J.	Dental education in the United States and Canada. New York, Carnegie Foundation, 1926. (Free.)
Gillett, H. W., & Irving, A. J.	Gold inlays by the indirect system. Brooklyn, Dental Items of Interest, 1932. $8.00.
Goepp, R. M.	Dental state board questions and answers. Philadelphia, Saunders, 1928. $4.50.
Goslee, H. J.	Principles and practice of crown and bridge-work. Brooklyn, Dental Items of Interest Pub. Co., 1926. $7.50.
Gottlieb, B., & Orban, B.	Die veränderungen der gewebe bei übermässiger beanspruchung der zähne. Leipzig, Georg Thieme, 1931. Unbound, $6.50. Bound, $7.00.
Graves, Lulu G.	Foods in health and disease. New York, Macmillan, 1932. $3.50.
Greenfield, A. L.	Interpretation of dental radiograms. Rochester, N. Y., Ritter Dental Mfg. Co., 1926. $2.50.
Gregory, W. K.	Our face from fish to man. New York, Putnam, 1929. $4.50.
Gwathmey, J. T.	Textbook of anesthesia. New York, Macmillan, 1929. $7.50.
Gwinn, C. D.	Textbook of exodontia. Philadelphia, Lea & Febiger, 1927. $2.75.
Gysi, Alfred	Special teeth for cross-bite cases. New York, Dentists' Supply Co., 1928. (Pamphlet.) (No purchase orders accepted.)
Hackh, I. W. D.	Chemical reactions and their equations. Philadelphia, Blakiston, 1928. $2.00.
Haden, R. L.	Dental infection and systemic disease. Philadelphia, Lea & Febiger, 1928. $2.50.
Hanau, R. L.	Dental engineering. Buffalo, N. Y., Author, 1926. (No purchase orders accepted.)
Hanau, R. L.	Hanau intraoral method vs. Gysi extraoral method. Buffalo, N. Y., Author, 1927. (No purchase orders accepted.)
Hanke, M. T.	Diet and dental health. Chicago, Univ. of Chicago Press, 1933. $1.00. (Limited time only.)
Hartman, L. L.	Teeth and the mouth. New York, Appleton, 1927. $1.50.
Head, Joseph	Everyday mouth hygiene. Philadelphia, Saunders, 1925. $1.00.
Hedstrom, Gustav	Gangrene of dental pulp and its treatment. Stockholm, Sweden, Isaac Marcus, 1927. (No purchase orders accepted.)
Headridge, Davis, & Gibson, S. K.	Dental anatomy, human and comparative. Outlines of dental science. Vol. 6. New York, Wood, 1928. $2.50.
Herbst, Emil, & Apffelsteadt, Max	Atlas and grundriss der missbildungen der kiefer and zähne. München, J. F. Lehmanns, 1928. (No purchase orders accepted.)

Hertzler, E.	Technic of local anesthesia. St. Louis, Mosby, 1925. $5.50.
Hess, Walter, & Zurcher, Ernst	Anatomy of the root-canals of the teeth. New York, Wood, 1925. $5.50.
Hewer, C. L.	Recent advances in anaesthesia and analgesia. Philadelphia, Blakiston, 1932. $3.50.
Hildebrand, G. Y.	Studies in masticatory movements of human lower jaw. Berlin, Gruyter, 1931. (No purchase orders accepted.)
Hodgen, J. D.	Practical dental metallurgy. St. Louis, Mosby, 1932. $3.75.
Hogeboom, F. E.	Practical pedodontia or juvenile operative dentistry and public health dentistry. St. Louis, Mosby, 1933. $6.50.
Hyatt, T. P.	Hygiene of mouth and teeth. Brooklyn, N. Y., Brooklyn Dental Pub. Co., 1929. $1.00.
Hyatt, T. P.	Prophylactic odontotomy: A practical and simple procedure for the prevention of caries in pit and fissure cavities. New York, Macmillan, 1933. $1.50.
Ivy, R. H., & Curtis, Lawrence	Fractures of the jaws. Philadelphia, Lea & Febiger, 1931. $4.50.
Jamieson, J. D. H.	Operative dentistry. Outlines of dental science. Vol. 9. New York, Wood, 1927. $2.50.
Jerman, E. C.	Modern x-ray technic. St. Paul, Bruce Pub. Co., 1928. $5.50.
Jordan, E. O.	Textbook of general bacteriology. Philadelphia, Saunders, 1931. $6.00.
Jordan, M. Evangeline	Operative dentistry for children. Brooklyn, Dental Items of Interest Pub. Co., 1927. $5.00.
Kanner, Leo	Folklore of the teeth. New York, Macmillan, 1928. $4.00.
Kells, C. E.	Dentists' own book, including a complete bookkeeping and recording system. St. Louis, Mosby, 1925. $7.50.
Kells, C. E.	Three score years and nine. New Orleans, The Author, 1926. $8.00.
Kennedy, Edward	Partial denture construction. Brooklyn, N. Y., Dental Items of Interest Pub. Co., 1928. $7.50.
Kent, E. N.	Business side of dentistry. St. Louis, Mosby, 1929. $5.00.
Korkhaus, Gustav	Moderne orthodontische therapie. Berlin, Meusser, 1932.
Kronfeld, Rudolf	Histopathology of the teeth and their surrounding structures. Philadelphia, Lea & Febiger, 1933. $7.00.
Kuttler, Yury	Mis investigaciones sobre la denticion en 15,240 ninos y 782 adultos habiendo hecho 28,557 examenes. Mexico, D. F., Facultad Odontologica de la Universidad Nacional Autonoma de Mexico, 1933.
LeGro, A. L.	Ceramics in dentistry. Brooklyn, N. Y., Dental Items of Interest Pub. Co., 1926. $7.50.
Leriche, R., & Policard, A.	Normal and pathological physiology of bone. St. Louis, Mosby, 1928. $5.00.
Leuck, Miriam S.	Study of dental clinics in the United States: 1930. Chicago, University of Chicago Press, 1932. $1.00.
Leuck, Miriam S.	Further study of dental clinics in the United States. Chicago, University of Chicago Press, 1932. $1.50.
Leven, Maurice, & Beck, Dorothy F.	Practice of dentistry and incomes of dentists in twenty states: 1929. Chicago, University of Chicago Press, 1932. $2.00.
Lindsay, Lilian	Short history of dentistry. London, John Bale, 1933. $1.50.
Livingston, Alexander	Dental histology. Outlines of dental science. Vol. 10. New York, Wood, 1928. $2.50.
Lloyd-Williams, E.	Dental mechanics: a manual for students and junior practitioners. London, Bale, 1931. $2.00.
Logan, J. D.	Dental prosthetics. Outline of dental science. Vol. 4. Edinburgh, Livingstone, 1926. $2.50.
Lucas, H. A.	Medicine for dental students. Baltimore, William Wood & Co., 1933. $2.75.
Margolis, H. M.	Conquering arthritis. New York, Macmillan, 1932. $2.00.

Marriott, W. M.	Infant nutrition: a textbook of infant feeding for students and practitioners of medicine. St. Louis, Mosby, 1930. $5.50.
Marsden, P. H.	Dental materia medica. Outlines of dental science. Vol. 3. Edinburgh, Livingstone, 1926. $2.50.
Marshall, J. A.	Diseases of the teeth; their diagnosis and treatment. Philadelphia, Lea & Febiger, 1926. $4.50.
Maximow, A. A., & Bloom, Wm.	Textbook of histology. Philadelphia, Saunders, 1930. $9.00.
McBride, W. C.	Juvenile dentistry. Philadelphia, Lea & Febiger, 1932. $2.75.
McCaw, Emma J.	Dental assistant. St. Louis, Mosby, 1926. $1.50.
McCollum, E. V., & Becker, Ernestine	Food, nutrition and health. Baltimore, Authors, 1933. $1.50.
McCollum, E. V., & Simmonds, Nina	Newer knowledge of nutrition. New York, Macmillan, 1929. $5.00.
McCoy, J. D.	Applied orthodontia. Philadelphia, Lea & Febiger, 1931. $4.50.
McGehee, W. H. O.	Textbook of operative dentistry. Philadelphia, Blakiston. 1930. $10.
Mead, S. V.	Diseases of the mouth. St. Louis, Mosby, 1932. $10.00
Mead, S. V.	Oral surgery. St. Louis, Mosby, 1933. $12.50.
Mellanby, May	Diet and the teeth: an experimental study. Part I. Dental structure in dogs. London, His Majesty's Stationery Office, 1929. $7.00.
Mellanby, May	Diet and the teeth: an experimental study. Part II. A. Diet and dental disease. B. Diet and dental structure in mammals other than the dog. London, His Majesty's Stationery Office, 1930. $1.00.
Merritt, A. H.	Periodontal diseases: diagnosis and treatment. New York, Macmillan, 1930. $4.00.
Moorehead, F. B., & Dewey, Kaethe W.	Pathology of the mouth. Philadelphia, Saunders, 1925. $7.00.
Neil, Ewell	Full denture practice. Nashville, Tenn., Marshall and Bruce Co., 1932.
Nevin, Mendell, & Puterbaugh, P. G.	Conduction, infiltration and general anesthesia in dentistry. Brooklyn, Dental Items of Interest Pub. Co., 1927. $6.00.
Nichols, I. G.	Prosthetic dentistry: an encyclopedia of full and partial denture prosthesis. St. Louis, Mosby, 1930. $12.50.
Okumura, Tsurukichi	Present status of dentistry in Japan. Tokyo, Japan, Japan Dental Assn., 1931. (Pamphlet.) (No purchase orders accepted.)
Orban, Balint	Dental histology and embryology. Philadelphia, Blakiston, 1929. $5.00.
Osgood, H. A.	Teeth and jaws roentgenologically considered. Annals of roentgenology, volume 5. New York, Hoeber, 1929. $10.00.
Ottolengui, Rodrigues	Table talks on dentistry. Brooklyn, Dental Items of Interest Pub. Co., 1928. $7.00.
Palmer, G. T., Derryberry, Mahew & Van Ingen, Philip	Health protection for preschool child: national survey of use of preventive medical and dental service for children under six. New York, Century, 1931. $2.50.
Perry, Maude A.	Dietetics and nutrition. St. Louis, Mosby, 1930. $2.50.
Phelps, Edith M.	Socialization of medicine. New York, Wilson, 1930. $0.90.
Pollia, J. A.	Fundamental principles of alveolo-dental radiology. Brooklyn, Dental Items of Interest Pub. Co., 1930. $8.00.
Posner, J. J.	Minor oral surgery simplified. Philadelphia, Patterson & White, 1928. $2.00.
Prinz, Herman	Dental formulary. Philadelphia, Lea & Febiger, 1930. $3.50.
Prinz, Herman	Dental materia medica and therapeutics. St. Louis, Mosby, 1926. $7.50.
Prinz, Herman	Diseases of soft structures of teeth. Philadelphia, Lea & Febiger, 1928. $6.50.
Prothero, J. H.	Prosthetic dentistry. Chicago, Medico-Dental Pub. Co., 1928. $10.00.
Pusey, W. A.	Doctor of the 1870's and 1880's. Baltimore, C. C. Thomas, 1932. $3.00.
Quigley, D. T.	Notes on vitamins and diets. Chicago, Consolidated Book Publishers, Inc., 1933. $1.00.

Raper, H. R.	Clinical preventive dentistry. Rochester, N. Y., Ritter Dental Mfg. Co., 1926. $3.50.
Rapp, F. W.	Elements of anatomical articulation or the mathematics of dental prosthetics. London, Bale, 1930. $2.00.
Ray, K. W.	Metallurgy for dental students. Philadelphia, Blakiston, 1931. $3.00.
Report of Committee on Growth and Development	Growth and development of the child. Part III. Nutrition. (A publication of White House Conference on Child Health and Protection.) New York, Century, 1932. $4.00.
Report of Committee on Public Health Organization	Public health organization. (A publication of White House Conference on Child Health and Protection.) New York, Century, 1932. $3.00.
Reports of Subcommittees on Nutrition and Health Centers	Nutrition service in the field. Child health centers: a survey. (A publication of White House Conference on Child Health and Protection.) New York, Century, 1932. $2.00.
Roberts, Lydia J.	Nutrition work with children. Chicago, University of Chicago Press, 1927. $3.50.
Rose, Mary S.	Foundations of nutrition. New York, Macmillan, 1927. $2.75.
Rukeyser, M. S.	Doctor and his investments. Philadelphia, Blakiston, 1931. $2.50.
Schroff, Joseph	Fundamentals of pathology. New York, W. A. Broder. 1929. $2.50.
Sears, V. H.	Full denture procedure. New York, Macmillan, 1929. $2.00.
Shaw, D. M.	Dental prosthetic mechanics. London, Arnold, 1927. $7.50.
Sherman, H. C.	Vitamins. New York, Chemical Catalogue Co., Inc., 1931. $6.00.
Sicher, Harry, & Tandler, Julius	Anatomie für Zahnärzte. Vienna, Julius Springer, 1928. (No purchase orders accepted.)
Silverman, S. L.	Principles and practice of oral surgery. Philadelphia, Blakiston, 1926. $6.00.
Simon, P. W.	Fundamental principles of systematic diagnosis of dental anomalies. Boston, Stratford, 1926. $5.00.
Simon, W., & Base, Daniel	Manual of Chemistry. Philadelphia, Lea & Febiger, 1927. $5.00.
Simons, A. M., & Sinai, Nathan	Way of health insurance. Chicago, University of Chicago Press, 1932. $2.00.
Simpson, C. O.	Advanced radiodontic interpretation. St. Louis, University Press, 1931. $35.00. (Because of the unusual price and its lack of durability a rental fee of $1.00 will be charged for this book for each two weeks it is in circulation.)
Simpson, C. O.	Technic of oral radiography. St. Louis, Mosby, 1928. $5.00.
Simpson, C. O.	Toothsome topics. St. Louis, University Press, 1931. $2.50.
Smith, D. T.	Oral spirochetes and related organisms in fusospirochetal disease. Baltimore, Williams & Wilkins, 1932. $4.50.
Smith, G. F. R.	Dental anaesthesia. Outlines of dental science. Vol. 1. Edinburgh, Livingstone, 1926. $2.50.
Smyth, Corisande, & Young, Matthew	Facial growth in children. London, His Majesty's Stationery Office, 1932. $0.75.
Sorrin, Sidney, & Miller, S. C.	Practice of periodontia. New York, Macmillan, 1928. $3.50.
Steadman, F. St. J.	Pyorrhea alveolaris. St. Louis, Mosby, 1927. $9.25.
Stieglitz, Julius	Chemistry in medicine. New York, Chemical Foundation, 1928. $2.00.
Stillman, P. R., & McCall, J. O.	Textbook of clinical periodontia. New York, Macmillan, 1927. $4.50.
Stillson, W. C.	Dental anatomy: classroom and laboratory quiz compend with supplementary notes. Phildelphia, Saunders, 1929. $2.25.
Stoloff, C. I.	Your teeth. New York, Dutton, 1929. $2.50.
Strang, R. H. W.	Textbook of orthodontia. Philadelphia, Lea & Febiger, 1933. $10.00.
Sure, Barnett	Vitamins in health and disease. Baltimore, Williams & Wikins Co., 1933. $2.00.

Suter, A. B. W.	Dentistry—a profession and a business. Rochester, N. Y., Ritter Dental Mfg. Co., 1930. $7.50.
Tanguy, T. V.	Science and practice of actinotherapy. St. Louis, Mosby, 1928. $3.00.
Toverud, K. U., & Toverud, Gottorm	Studies on the mineral metabolism during pregnancy and lactation and its bearing on the disposition to rickets and dental caries. Uppsala, Almqvist & Wiksells Boktryckeri-A-B, 1931. (Pamphlet.) (No purchase orders accepted.)
Turner, C. R., & Anthony, L. P.	American textbook of prosthetic dentistry. Philadelphia, Lea & Febiger, 1932. $10.00.
Tyree, C.	Dental health in the prevention of disease. London, Kentucky, Author, 1927. $2.75.
Ullmann, E. V.	Diet in sinus infections and colds. New York, Macmillan, 1933. $2.00.
Urling, L. H.	Your teeth; their care and preservation. Philadelphia, Dorrance, 1932. $1.50.
Wallace, J. S.	Physiology of oral hygiene and recent research. London, Bailliere, Tindall & Cox, 1929. $4.00.
Wallace, J. S.	Teeth and health. London, Faber & Gwyer, 1926. $1.40.
Wallace, J. S.	Variations in the form of the jaws, with special reference to their etiology and their relation to the occlusion of the dental arches. New York, Wood, 1926. $6.00.
Ward, M. L.	American textbook of operative dentistry. Philadelphia, Lea & Febiger, 1926, $10.00.
Webster, A. E.	Manual for dental assistants. Philadelphia, Lea & Febiger, 1932. $3.50.
Weinberger, B. W.	Orthodontics: an historical review of its origin and evolution. 2 vols. St. Louis, Mosby, 1926. $25.00.
William, Maurice	Sun Yat-Sen versus communism. New evidence establishing China's right to the support of democratic nations. Baltimore, Williams & Wilkins, 1932. $5.00.
Williams, Pierce, & Chamberlain, Isabel	Purchase of medical care through fixed periodic payment. New York, National Bureau Economic Research, 1932. $3.00.
Winter, G. B.	Principles of exodontia, as applied to the impacted mandibular third molar. St. Louis, American Medical Book Co., 1926. $15.00.
Winter, Leo	Textbook of exodontia. St. Louis, Mosby, 1931. $10.00.
Wolfenden, H. H.	Real meaning of social insurance. Toronto, Canada, Macmillan, 1932. $2.00.
Woodbury, C. E.	Making and filling of cavities in the proximal surface of the front teeth with gold foil. Omaha, Neb., Author, 1929. $5.00.
Zemsky, J. L.	Oral diseases: practical treatise offering diagnostic and therapeutic aid to the practitioner of medicine and dentistry. Brooklyn, N. Y., Physicians and Surgeons Book Co., 1930. $8.00.
Zemsky, J. L.	Outline of oral surgery. Brooklyn, N. Y., Physicians and Surgeons Book Co., 1930. $4.50.
Zoethout, W. D.	Textbook of physiology. St. Louis, Mosby, 1928. $4.50.

GIVE WRITTEN INSTRUCTIONS TO YOUR DENTURE PATIENTS

A booklet entitled "Your New Teeth," may be procured for distribution to your patients from the Library Bureau of the American Dental Association. This booklet is intended primarily for the patient who is wearing dentures for the first time. It enumerates some of the difficulties that may be encountered when one first wears dentures and offers suggestions as to how these difficulties may be overcome. There is also much of interest to the patient who has been wearing dentures, as information is given regarding the care, repair and rebasing of dentures. The information in this booklet was taken from the article entitled "Instructions for the Edentulous Patient," by B. L. Hooper, which was published in THE JOURNAL, February, 1932. The price of these booklets is: 25, $1.00; 50, $1.50; 100, $2.00. Kindly send remittances with order. A sample of booklet will be sent on request. Fifteen thousand of these have been ordered to date.

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